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NOVEMBER 1982

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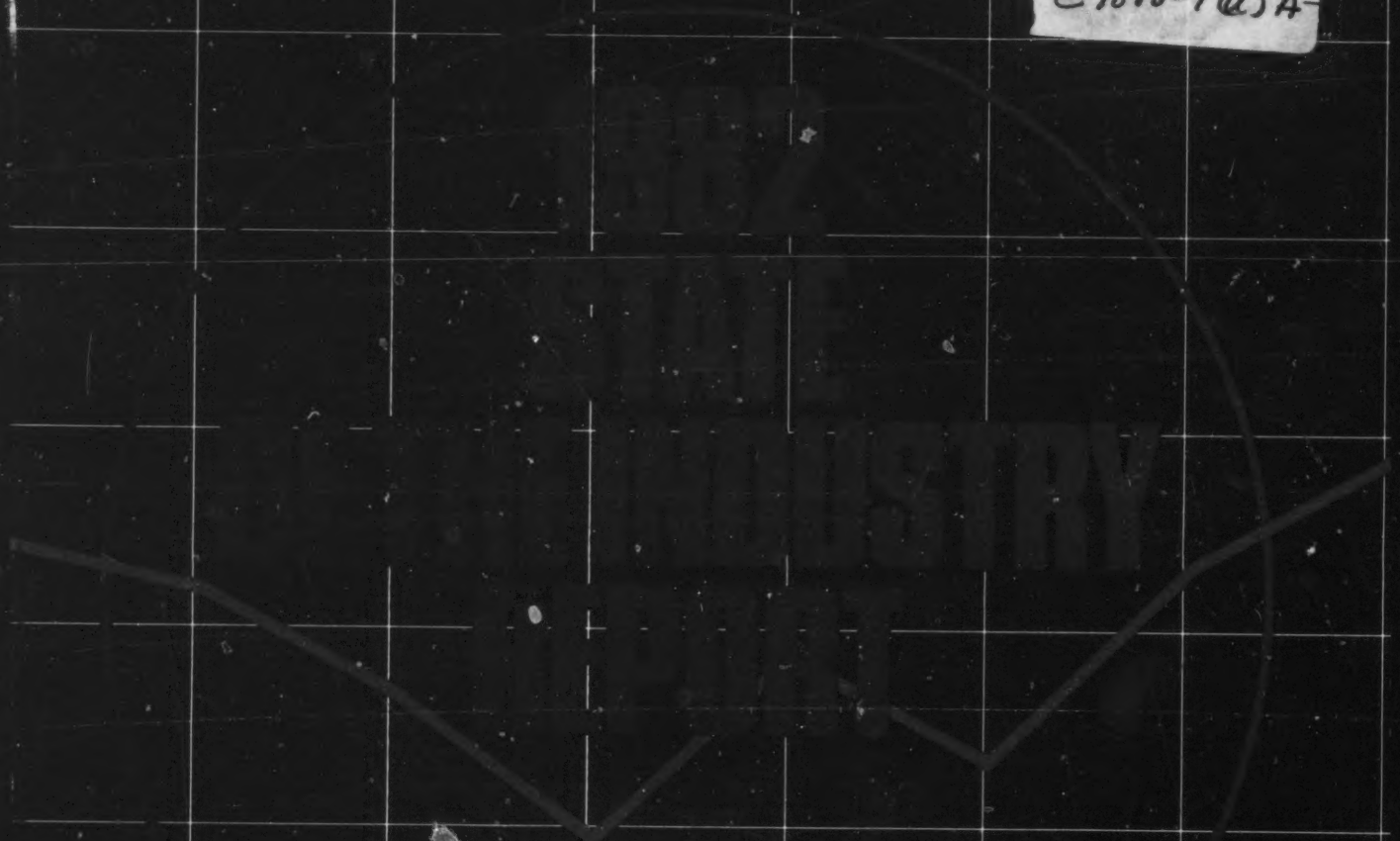

Trends in markets, production, plans to buy for die casting, extrusion, forging, investment casting, powder metallurgy, roll forming, stamping

Forging technologies for the aerospace industry

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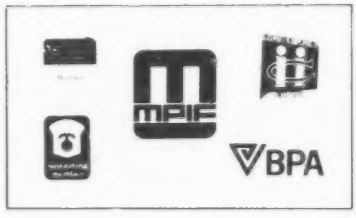


STATE OF THE 1982 INDUSTRY

By JAMES E. BILLINGSLEY, associate editor

It comes as no surprise that the precision metal industries are feeling the impact of the recession. Shipments are down in several industries, backlogs are drying up, and new orders are slow. High interest rates are delaying expansion plans. Imports are beginning to affect the business of many precision metal parts manufacturers.

The pessimistic mood of the economy is reflected in our respondents' replies to our questionnaires, particularly in their view of probable shipments for 1983. Although many respondents expect some improvement in 1983, their responses are decidedly more pessimistic than in previous years (our respondents are normally an optimistic lot). Perhaps the only bright spots in the near-term forecast are the low inventory levels now maintained by most firms, meaning that any significant pick-up in product sales will result in increased production, and the recent softening in short-term interest rates.

The precision metal industries still retain the qualities which brought them rapid growth after World War II: labor savings, high production rates and high material usage. Prospects for further growth appear good—once the economy as a whole starts to grow.

This report is based primarily on information from a survey conducted during April-June 1982 by Penton/IPC Marketing Research & Economic Analysis. Questionnaires were sent to management and production executives in each of the seven industries, chosen from the circulation list of PRECISION METAL. Data from other sources was included in the die casting, extrusion, forging and powder metallurgy reports.

The respondents' output chart gives total industry custom and captive percentages. These were obtained by taking the "custom & captive" category from the "respondents to our survey were" chart, adding up the fractions of their output that were custom and were captive, and adding these totals to the numbers of purely custom and purely captive respondents. Custom and captive output percentages were then derived from these numbers.

The geographic distributions indicate the percentage of plants producing or using precision metal parts in the regions shown on the maps. The relative height of a region is proportional to the relative concentration of an industry's producers or users in that region.

Plants are categorized by size in two ways: by number of employees and by shipment volume.

For capital equipment, the "number of plants" column indicates the number of responding plants having a given piece of equipment installed in the listed size range (for example, 29 responding plants had mechanical presses installed with capacities between 1000 and 2000 tons in our forging survey). The number given for "total" indicates the number of plants with the given type of equipment installed, not the total of the column above it (thus, the "number of plants total" for mechanical forging presses is 76, not 120).

The "number of machines" column gives the number of machines our respondents have in each size category. Plant averages were computed using the number of plants indicated on the "based on" line, not on the number of plants having machines in a given size category.

Industry totals for installed capital equipment in all industries were projected by assuming a total number of plants in an industry, dividing this number by the number of plants that answered the appropriate question, and multiplying this ratio by our respondents' totals. For example, we assumed an industry total of 900 plants for forging, 160 plants answered the question on forging presses, and our respondents had a total of 374 mechanical presses. Performing the multiplications, a projection of about 2104 installed mechanical forging presses results. This number was rounded off to 2100 because of the errors inherent in projecting industry totals from data gathered from a fraction of the industry. All projections were rounded off to no more than two significant figures. Projected totals smaller than 100 were rounded off to the nearest ten because it was felt that these projections were likely to have a larger percentage error than other projections. Note that projections for machine sizes may not add up to the total projection due to rounding.

The plant totals on which the projections were based were estimated from our knowledge of the precision metal industries, confirmed with outside sources in some cases.

No projections were made for buying plans. The number of plants planning to buy machines in a given size category are given along with the number of machines they plan to buy.

It was assumed that all responses for capital equipment were complete. Thus, for example, if the question on cold headers in the forging questionnaire was left blank, it was assumed that no cold headers were installed in that plant.

Expendable supplies projections were prepared like capital equipment projections, except for die casting, extrusion and forging. The methods used in these industries are explained in their reports.

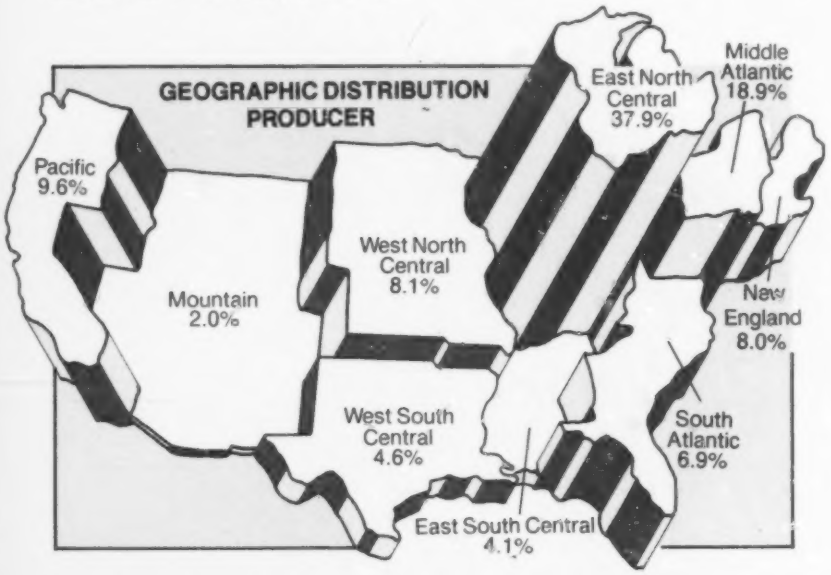
The industry surveys were supervised by Robert Schenk, director, Penton/IPC Marketing Research & Economic Analysis. John Szucs, Penton/IPC artist, was responsible for the design and production of the section.

STATE OF THE DIE CASTING INDUSTRY

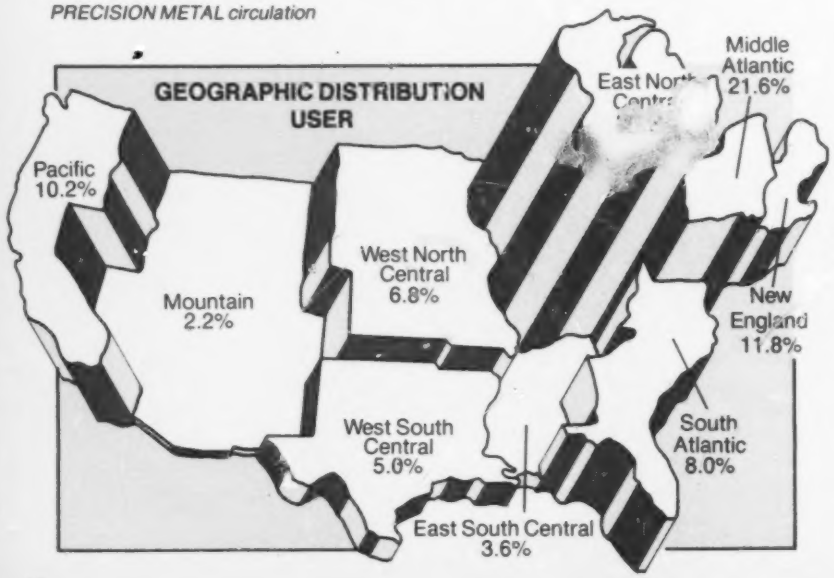
Questionnaires were sent to 2144 management and production executives in the die casting industry. A total of 228 useful responses was received for a response rate of 10.6%. An industry total of 800 plants was assumed for the purpose of projecting industry totals.

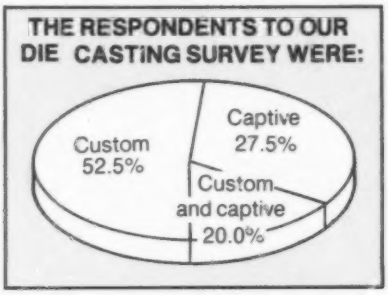
The automobile industry is still the largest market for die castings (both aluminum and zinc), and the problems in the automobile industry are reflected in the performance of the die casting industry. Although 1981 was not quite as poor as 1980 for Detroit, 1982 appears to be the weakest sales year for the automakers in many years. Not only are total sales down, but imports are grabbing about 30% of the domestic market currently.

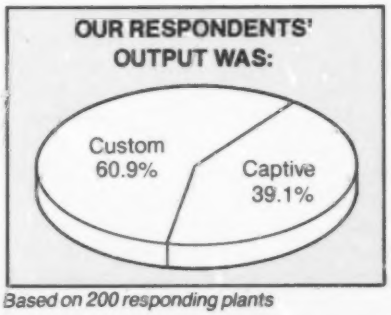
The effect of the changing automotive industry on zinc die casting can be seen clearly in the figures on zinc die casting end-use markets from Zinc Institute. Tonnage going into automotive components has fallen from 49.3% in 1977 to 32.5% in 1981. Since 1976, poundage per car has fallen nearly in



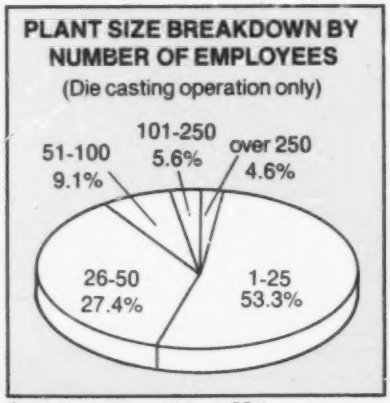
Based on computer analysis of PRECISION METAL circulation





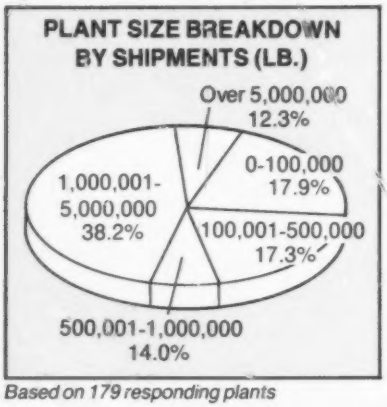


Based on 200 responding plants



Average employees/plant: 58.1
Based on 194 responding plants

half—from almost 45 pounds in 1976 to 22.7 pounds in the 1982 models. Although thin wall zinc technology has contributed to the decline in poundage, many applications have been lost. Unfortunately for zinc die casters, the poundage lost in the automotive industry has not been made up elsewhere.



Based on 179 responding plants

Shipments in other industries reflect the sluggish condition of the economy in general. It is to be expected that shipments to these markets will increase as the economy improves. One problem faced by die casters—both of aluminum and of zinc—is that the most rapidly growing areas of the economy—electronic devices, for example—have not been large users of die castings.

Alumnium shipments were actually up slightly in 1981, according to the U.S. Department of Commerce. This is probably due in part to increased automotive usage. The drive for automotive weight reduction that has damaged zinc die casting is of benefit to aluminum die casting, with many potential applications for aluminum die castings waiting to be tapped. Magnesium die castings are also likely future beneficiaries of this trend. As noted last year, the best thing for the die casting industry will be a growing economy.

Aluminum shipments are largely captive, while zinc shipments are primarily custom—and seem to be growing more so, with the custom/captive ratio for zinc reaching 2.63 in 1981 (it had been as low as 1.23 in 1974). As with most industries, the industry is most heavily concentrated where user concentration is heaviest, in the East North Central region.

With high interest rates pushing up acquisition costs of new capital equipment, die casting machine rebuilding is becoming increasingly popular, especially for hot chamber machines. The greatest number of die casting machines are between 11 and 15 years old.

Electric furnaces seem to be gaining in popularity, especially for holding. Material handling equipment (robots,

DIE CASTING SHIPMENTS 1972-81: U.S. DEPT. OF COMMERCE

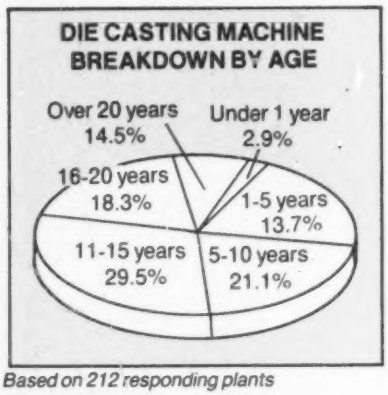
Metal	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Aluminum										
Custom	465	523	457	320	416	469	493	491	404	437
Captive	727	782	633	535	786	835	791	703	482	519
Total	**1192**	**1305**	**1091**	**854**	**1201**	**1305**	**1284**	**1194**	**887**	**957**
Zinc										
Custom	475	527	371	307	402	355	344	344	238	242
Captive	306	348	303	237	278	242	200	161	108	92
Total	**780**	**874**	**675**	**545**	**679**	**597**	**544**	**505**	**346**	**334**
Magnesium	38.0	24.2	23.9	17.5	14.2	26.8	23.6	20.2	14.1	12.9
Copper & base	23.0	23.0	17.9	9.5	9.6	7.9	7.4	7.3	3.5	3.1
Lead	46.0	40.7	38.6	35.4	46.5	30.5	31.5	25.3	34.8	31.4

DIE CASTING SHIPMENT TRENDS

Metal or alloy	1982 change (%)	1983 Expectation (%)		
		Increase	Decrease	About the same
Zinc	+8.0	47.8	13.2	39.0
Aluminum	+1.9	53.7	12.7	33.6
Magnesium	+4.8	57.1	28.6	14.3
Brass	−1.9	37.5	37.5	25.0
Lead	+25.1	57.1	0.0	42.9

The 1982 change column represents respondents' expected change in shipment poundage from 1980, expressed in percent.
The 1983 expectation columns give the percentage of respondents expecting 1983 shipments to increase, decrease or stay about the same as in 1982.

Based on 179 responding plants



Based on 212 responding plants
97 to 199 responding plants had
197 machines rebuilt

HOT CHAMBER DIE CASTING MACHINES — INSTALLED				
Size in tons (unlocking force)	No. of plants	No. of machines	Average/ plant	Project ind. total
Under 100	66	379	1.8	1500
101-250	74	275	1.3	1100
251-400	63	188	0.9	730
401-550	42	141	0.7	550
551-700	29	54	0.3	210
701-850	9	17	0.1	70
851-1000	4	13	0.1	50
over 1000	4	18	0.1	70
Total	**144**	**1075**	**5.2**	**4200**

Based on 206 responding plants

COLD CHAMBER DIE CASTING MACHINES — INSTALLED				
Size in tons (unlocking force)	No. of plants	No. of machines	Average/ plant	Project ind. total
Under 100	11	39	0.2	150
101-250	31	62	0.3	240
251-400	61	187	0.9	730
401-550	54	154	0.7	600
551-700	73	360	1.7	1400
701-850	41	150	0.7	580
851-1000	24	54	0.3	210
over 1000	16	170	0.8	660
Total	**117**	**1182**	**5.7**	**4600**

Based on 206 responding plants

HOT CHAMBER BUYING AND REBUILDING PLANS				
	Plan to buy by end 1983		Plan to rebuild by end 1983	
Size in tons (locking force)	No. of plants	No. of machines	No. of plants	No. of machines
Under 100	14	43	20	60
100-250	10	13	21	43
251-400	8	9	13	17
401-550	4	4	9	13
551-700	3	3	4	4
701-850	0	0	1	1
851-1000	2	2	0	0
over 1000	0	0	0	0
Total	**34**	**74**	**59**	**141**

Based on 206 responding plants

COLD CHAMBER BUYING AND REBUILDING PLANS				
	Plan to buy by end 1983		Plan to rebuild by end 1983	
Size in tons (locking force)	No. of plants	No. of machines	No. of plants	No. of machines
Under 100	0	0	2	2
100-250	2	2	6	7
251-400	6	9	14	19
401-550	10	12	17	26
551-700	18	43	19	33
701-850	8	9	6	8
851-1000	5	7	1	1
over 1000	3	5	5	6
Total	**38**	**87**	**45**	**102**

Based on 206 responding plants

FURNACES

Type	Now have installed: No. of plants	No. of furnaces	Average/ plant	Projected ind. total	Plan to buy by end 1983: No. of plants	No. of furnaces
Breakdown						
Fuel-fired	159	513	2.4	1900	32	57
Electric	47	217	1.0	800	12	26
Holding						
Fuel-fired	96	596	2.7	2200	8	31
Electric	47	468	2.2	1700	12	35

Based on 217 responding plants

MATERIAL HANDLING EQUIPMENT

Type	Now have installed: No. of plants	No. of machines	Average/ plant	Projected ind. total	Plan to buy by end 1983: No. of plants	No. of machines
Casting conveyors	88	419	1.9	1500	21	69
Scrap conveyors	81	272	1.3	1000	13	26
Robots	48	193	0.9	710	15	42
Extractors	40	204	0.9	750	10	12

Based on 217 responding plants

DIE MAKING EQUIPMENT

Type	Now have installed: No. of plants	No. of machines	Average/ plant	Projected ind. total	Plan to buy by end 1983: No. of plants	No. of machines
Duplicators	49	77	0.4	280	6	6
EDM machines	63	111	0.5	410	11	13
N/C equipment	21	54	0.2	200	12	16

Based on 217 responding plants

FINISHING EQUIPMENT

Type	Now have installed: No. of plants	No. of machines	Average/ plant	Projected ind. total	Plan to buy by end 1983: No. of plants	No. of machines
Vibratory/barrel	142	398	1.8	1500	22	37
Polishing/buffing	64	481	2.2	1800	7	13
Paint spray	59	121	0.6	450	4	4
Plating	48	82	0.4	300	4	4

Based on 217 responding plants

TRIM PRESSES

Type	Now have installed: No. of plants	No. of machines	Average/ plant	Projected ind. total	Plan to buy by end 1983: No. of plants	No. of machines
Mechanical	105	577	2.7	2100	9	17
Hydraulic	147	1363	6.3	5000	27	64

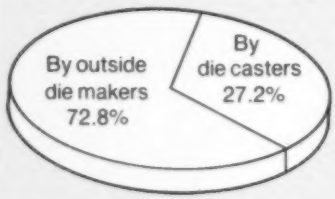
Based on 217 responding plants

OTHER CAPITAL EQUIPMENT

Type	Now have installed: No. of plants	No. of machines	Average/ plant	Projected ind. total	Plan to buy by end 1983: No. of plants	No. of machines
Automatic ladles	80	418	1.9	1500	28	68
Automatic lubricators	105	765	3.5	2800	27	87
Automatic lube mixers	66	199	0.9	730	5	8
Molten metal pumps	53	178	0.8	660	2	12

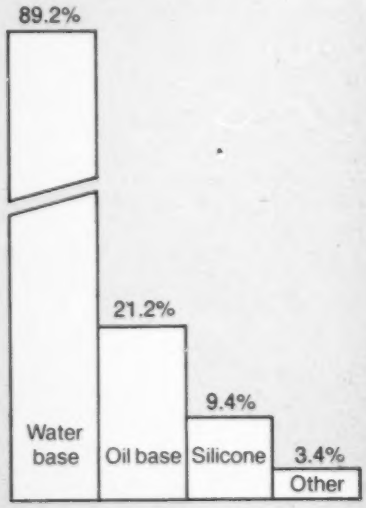
Based on 217 responding plants

WHERE DIES ARE MADE



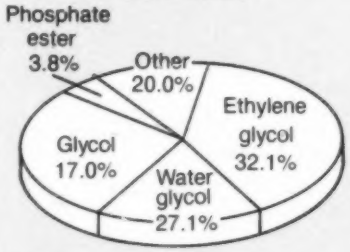
Based on 208 responding plants

TYPES OF DIE & PLUNGER LUBRICANT USED



Based on 203 responding plants
Some plants use more than one type of lubricant

TYPES OF HYDRAULIC FLUID USED



Based on 159 responding plants

INSTRUMENTATION AND CONTRLS

Type	Now have installed: No. of plants	No. of machines	Average/ plant	Projected ind. total
Pyrometers	150	1291	6.4	5100
Die temperature controls	53	293	1.4	1200
Furnace controls	137	1544	7.6	6100
Shot controls	67	7529	2.4	2000
Metal temperature controls	123	1659	8.2	6500
Automatic process sequencing	82	1208	56.0	4800

Based on 203 responding plants

conveyors, extractors) appears to be gaining slowly.

Although production equipment is now being added at a slow pace, instrumentation and automatic controls are making large inroads into the industry.

Most dies are made by outside die makers. Virtually all hydraulic fluids used today are of a fire-resistant variety.

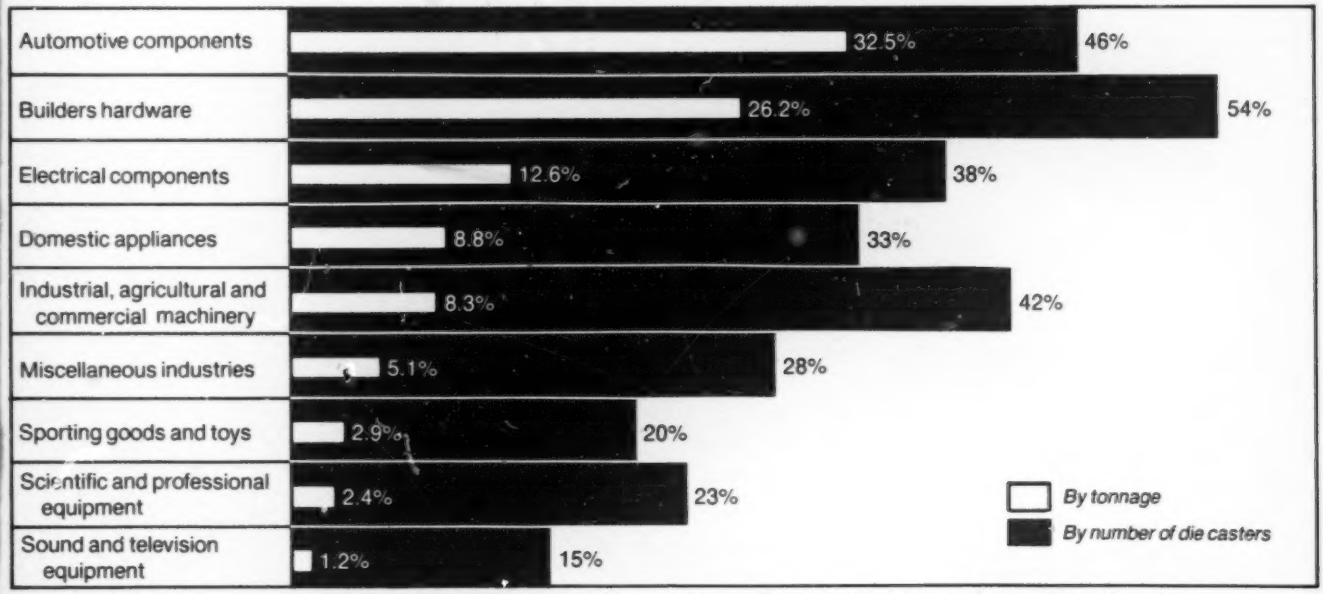
Industry expendable supplies usage was estimated by taking the ratio of known die casting shipments (U.S. Dept. of Commerce) to our respondents' shipments, and multiplying our respondents' expendable supplies usage by this ratio.

EXPENDABLE SUPPLIES

Type	No. of respondents	Respondents used	Average/ plant	Projected ind. total
Die steel	117	2,841,920 lb	24,290 lb	6,300,000 lb
Die & plunger lube	155	455,733 gal	2940 gal	1,100,000 gal
Hydraulic fluid	159	821,790 gal	5168 gal	1,900,000 gal
Crucibles	69	681	3.8	1600
Goosenecks	104	758	4.3	1800
Melting kettles	93	762	4.3	1800
Plunger tips	119	15,495	87.1	37,000
Die heaters	44	535	3.0	1300
Nozzles	104	3605	20.3	8000
Shot sleeves	106	1655	9.3	3700
Plunger rings	97	28,006	157.3	66,000
Thermocouple tubes	125	13,816	83.7	30,000
Ladles & skimmers	137	9432	53.0	21,000
Die lubricators (manual)	76	805	4.5	1900

Based on 178 responding plants

ZINC DIE CASTING END-USE MARKETS



Tonnage breakdown gives percentage of die casting shipments going into each industry; number of die casters gives percentage of zinc die casters producing components for each industry. Zinc Institute says that there are 428 zinc die castings.
Source: Zinc Institute Inc.

STATE OF THE EXTRUSION INDUSTRY

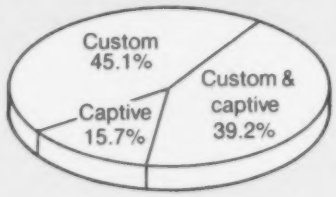
Questionnaires were sent to 1200 management and production executives in the extrusion industry. A total of 52 usable responses was received for a response rate of 4.3%. The number of plants in the industry was estimated at 225 for the purpose of estimating industry totals.

The extrusion industry has a large custom & captive segment with relatively few captive plants. As a result, our respondents' output was primarily custom.

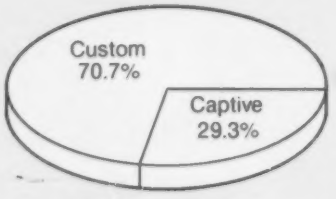
Most extrusion plants produce only alumnium extrusions, with a few plants producing extrusions in copper-base alloys, ferrous materials, and even exotic metals.

Aluminum extrusion shipments were off again in 1981, both for shapes and for pipe & tube. According to the Aluminum Association, the drop in shapes was about 5%, with the biggest decline coming in the transportation market. The building & construction market,

THE RESPONDENTS TO OUR EXTRUSION SURVEY WERE:

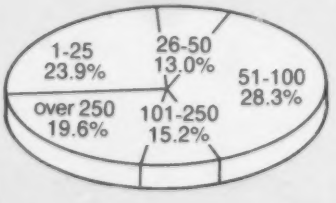


THEIR OUTPUT WAS:



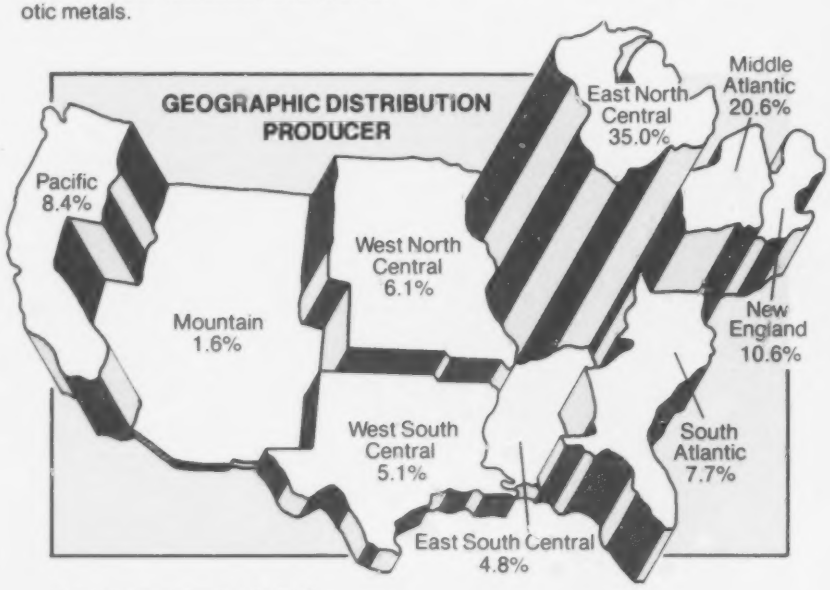
Based on 51 responding plants

PLANT SIZE BREAKDOWN BY NUMBER OF EMPLOYEES:



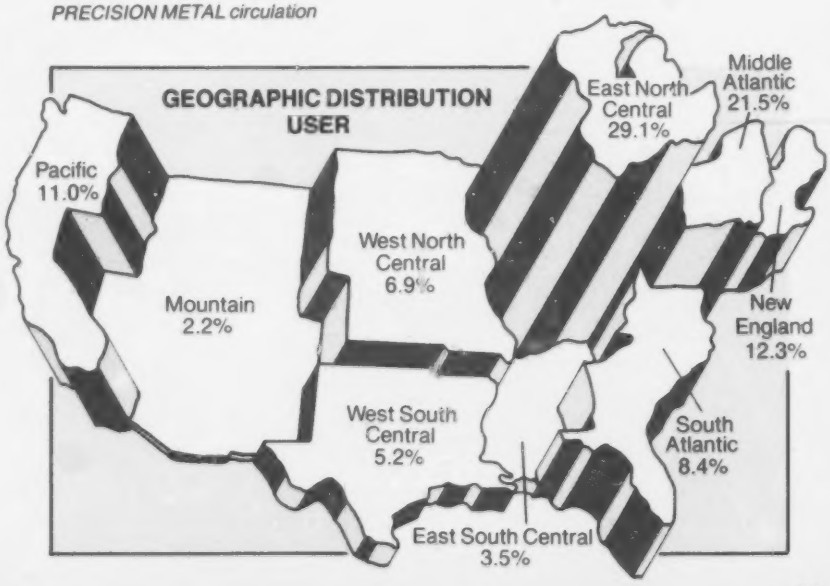
Average employees/plant: 151.2
Based on 46 responding plants

GEOGRAPHIC DISTRIBUTION PRODUCER



Based on computer analysis of PRECISION METAL circulation

GEOGRAPHIC DISTRIBUTION USER



ALUMINUM EXTRUSION SHIPMENTS, 1972-1981										
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Extruded shapes										
Building & construction	1250	1302	1074	812	1019	1163	1235	1215	1176	1163
Transportation	328	437	424	234	350	427	491	499	390	325
Consumer durables	85	113	109	70	94	106	133	117	96	88
Electrical	97	114	117	78	94	89	101	106	88	76
Machinery & equipment	67	79	84	72	81	88	115	108	88	80
Containers & packaging	1	—	—	—	—	—	—	1	—	—
Other	48	49	48	33	43	31	24	28	37	63
Domestic total	1876	2094	1856	1299	1681	1904	2099	2074	1875	1795
Exports	8	17	18	14	10	9	17	22	25	9
Extruded shapes total	**1884**	**2111**	**1874**	**1313**	**1691**	**1913**	**2116**	**2096**	**1900**	**1804**
Extruded pipe & tube										
Building & construction	47	46	42	27	33	31	29	31	23	18
Transportation	16	20	18	14	18	21	24	18	13	17
Consumer durables	20	21	19	13	18	22	28	21	19	21
Electrical	61	69	56	35	46	44	41	37	62	51
Machinery & equipment	38	55	65	31	53	45	35	29	26	21
Other	8	8	6	3	3	2	2	2	3	3
Domestic total	190	219	206	123	171	165	159	138	126	99
Exports	5	10	15	14	19	20	18	15	15	14
Pipe & tube total	**195**	**229**	**221**	**137**	**190**	**185**	**177**	**153**	**141**	**113**

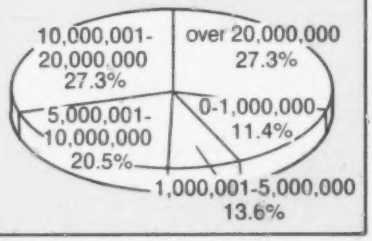
All figures are in million of pounds
Source: Aluminum Association

SHIPMENT TRENDS				
Metal or alloy	1982 change	1983 expectation (%)		
	(%)	Increase	Decrease	About the same
Aluminum	+0.7	61.8	11.8	26.5
Brass	−4.8	60.0	40.0	0.0
Copper	−0.6	50.0	0.0	50.0

Based on 39 responding plants

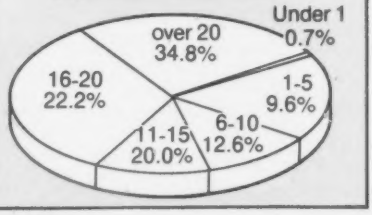
EXTRUSION PRESSES						
Size (tons)	Now installed				Plan to buy by end 1983	
	Number of plants	Number of presses	Average/ plant	Projected ind. total	Number of plants	Number of presses
Under 1000	11	13	0.3	60	1	1
1000-1499	15	18	0.3	80	0	0
1500-1999	24	42	0.8	180	1	1
2000-2999	22	30	0.6	130	1	1
3000-3999	11	16	0.3	70	2	2
4000-4999	4	4	0.1	20	0	0
5000-6999	4	7	0.1	30	0	0
7000 & over	3	7	0.1	30	1	2
Total	**52**	**139**	**2.7**	**600**	**5**	**7**

PLANT SIZE BREAKDOWN BY SHIPMENTS



Numbers in pie chart are shipments in pounds
Based on 46 responding plants

EXTRUSION PRESS AGE DISTRIBUTION



Ages in years
Based on 52 responding plants

easily the largest for extruded shapes, has held up relatively well despite the slump in the economy, particularly in residential housing. Pipe & tube shipments have continued to decline, with 1981 shipments less than half of the 1973 level. Our respondents expect shipments to remain flat through 1982, with some increase in 1983.

Although extrusion plants are few in number, they tend to have high production rates per plant. Over half of our respondents reported 1981 production in excess of 10,000,000 pounds.

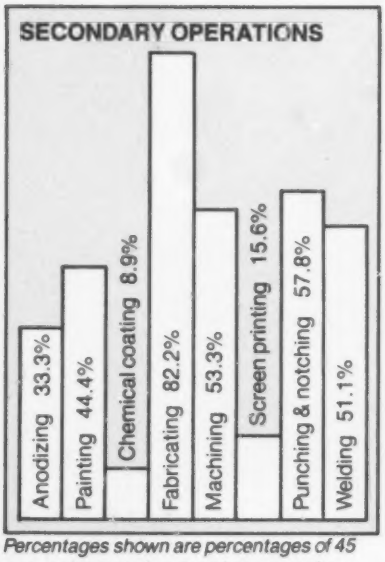
Most installed extrusion presses fall in the range from 1000 to 4000 tons capacity. Very few presses have capacities larger than 4000 tons. Buying plans for presses are presently very limited, even though many presses are over 20 years old.

Secondary operations are performed by most extruders, especially fabrication. Machining, punching & notching, and welding are also frequently performed.

The majority of dies used by extruders are made by outside die mak-

AUXILIARY EQUIPMENT						
Type	Now installed				Plan to buy by end 1983	
	Number of plants	Number of machines	Average/ plant	Projected ind. total	Number of plants	Number of machines
Automatic lubricators	21	56	1.1	250	1	1
Billet saws	41	79	1.6	360	4	6
Billet shears	6	8	0.2	40	1	2
Runout tables	48	136	2.7	610	4	5
Stretchers, detwisters	38	100	2.0	450	2	3
Billet casters	25	57	1.1	260	1	1
Billet heaters, induction	23	54	1.1	240	2	5
Billet heaters, fuel	31	92	1.8	410	7	11
Heat treat ovens	42	137	2.7	620	2	3
Cut-off saws	48	192	3.8	860	3	5
Burner controls	24	119	2.4	540	1	1
EDM machines	14	21	0.4	100	2	2
Heat recovery equipment	13	27	0.5	120	3	5

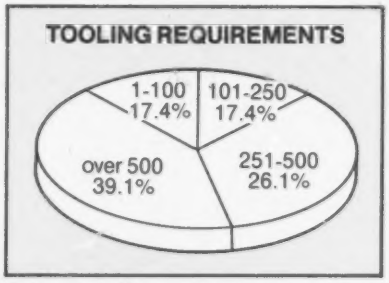
Based on 50 responding plants



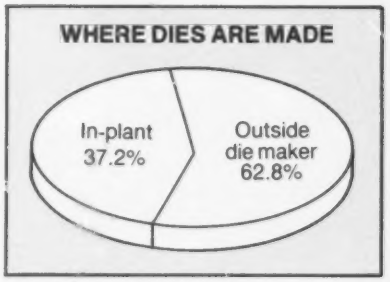
Percentages shown are percentages of 45 respondents performing given operations

EXPANDABLE SUPPLIES				
Type	Number of plants	Respondents used	Average/ plant	Projected ind. total
Fire resistant hydraulic fluid	20	40,580 gal	1015 gal	150,000 gal
Petroleum hydraulic fluid	31	153,020 gal	3826 gal	580,000 gal
Die lubricants	31	19,381 gal	485 gal	120,000 gal
Graphite	28	22,592 ft²	565 ft²	85,000 ft²

Based on 40 responding plants



Ranges indicate new dies per year per plant
Percentages indicate percentage of respondents using dies in given ranges in 1981
46 respondents used 40,224 new dies in 1981
36% of these were for new shapes
Average/plant: 874
Projected ind. total: 150,000



Based on 51 responding plants

ers. An extrusion plant tends to use many new dies per year, with over 250 used by nearly two-thirds of this year's respondents.

Projections for industry usage of expendable supplies were made by a percentage of shipments method. Known industry extrusion shipment totals from the Aluminum Association were divided by our respondents' reported shipments. Expendable supplies totals from our respondents were then multiplied by this ratio to arrive at the projected industry totals.

DIE SUPPLIES				
Type	Number of plants	Respondents used	Average/ plant	Projected ind. total
Dummy blocks	35	2033	49.6	11,000
Holder blocks	15	875	21.3	4800
Containers	25	50	1.2	270
Rams	19	86	2.1	470
Liners	31	189	4.6	1000
Mandrels	11	1588	38.7	8700

Based on 41 responding plants

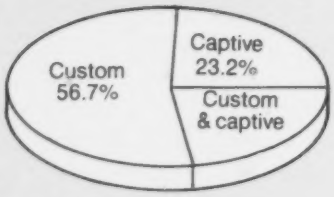
STATE OF THE FORGING INDUSTRY

Questionnaires were sent to 1391 management and production executives in the forging industry. We received 169 useful responses for a response rate of 12.1%. An industry size of 900 plants was used to project industry totals.

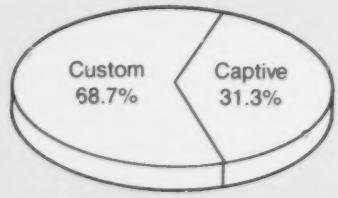
Custom impression die shipments remained about the same or slipped slightly from 1980, although dollar volumes increased. The only increases were registered in common alloy steel, stainless steel, brass & copper, and high-temperature materials. All metals grew in sales dollar volume except for the other non-ferrous category.

Most market areas grew in sales dollar volume over 1980. The biggest losers were the trucks, buses, trailers category, which slipped from third to fourth place among markets, and railroad equipment. The big winners were

THE RESPONDENTS TO OUR FORGING SURVEY WERE:

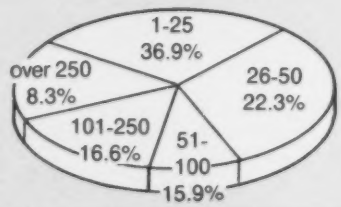


THEIR OUTPUT WAS:



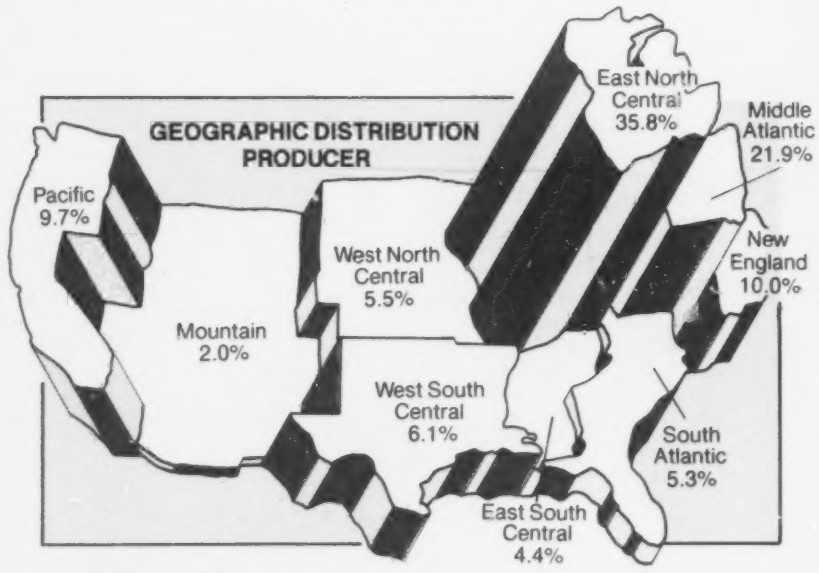
Based on 164 responding plants

PLANT SIZE BREAKDOWN BY NUMBER OF EMPLOYEES:
(forging operation only):



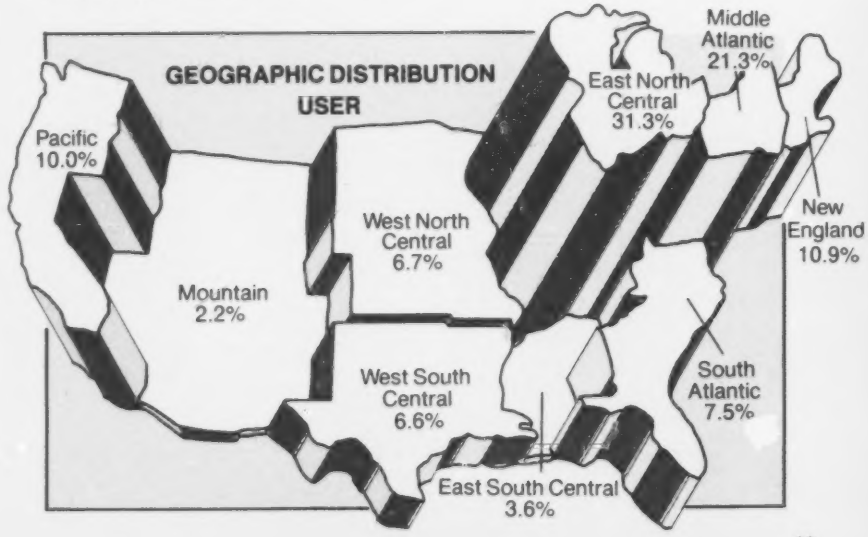
Average employees/plant: 86.8
Based on 157 responding plants

GEOGRAPHIC DISTRIBUTION PRODUCER



Based on computer analysis of PRECISION METAL circulation

GEOGRAPHIC DISTRIBUTION USER



SALES OF COMMERCIAL CLOSED DIE FORGINGS 1971-1981

TYPE OF METAL	1971		1976		1978		1980		1981	
	Dollars	Net Wt. (tons)	Dollars	Net Wt. (tons)	Dollars	Net Wt. (tons)	Dollars	Net Wt. (tons)	Dollars	Net Wt. (tons)
FERROUS										
Carbon Steel	388,488	803.6	656,800	750.6	824,730	734.1	778,316	522.0	844,762	495.6
Common Alloy Steel	214,492	322.3	494,100	399.1	624,744	405.5	716,995	364.5	813,123	368.3
Stainless Steel	45,839	12.2	64,100	12.8	80,755	11.5	108,418	11.8	116,491	13.7
TOTAL FERROUS	648,819	1138.1	1,215,000	1,162.5	1,530,031	1,150.0	1,603,729	898.3	1,774,376	877.5
NON-FERROUS										
Aluminum	82,544	31.0	141,600	32.8	223,504	40.3	285,506	32.2	298,432	31.3
Titanium	62,854	4.4	126,200	4.6	143,971	5.1	247,554	5.4	360,739	4.9
Brass & Copper	53,142	26.5	99,400	21.6	103,798	26.0	110,680	22.8	119,694	25.0
Other Non-ferrous*	5,042	2.0	7,200	0.8	8,841	0.5	7,712	0.4	6,920	0.4
TOTAL NON-FERROUS	203,568	63.0	374,400	5.9	480,114	71.9	651,452	61.3	785,785	61.5
TOTAL HI-TEMP**	81,355	8.1	124,900	6.1	157,558	7.2	287,992	8.0	322,487	8.4
TOTAL $ VOLUME	933,722		1,714,300		2,167,703		2,543,173		2,882,648	

*Other includes magnesium, zinc and other.

**Those alloys whether iron, nickel or cobalt base or others suitable for use at temperatures of 1000F.

All dollar and weight values are expressed in thousands.

This data does not include (1) shipments of aircraft blades and buckets from specialized shops devoted primarily to that work; (2) products forged at temperatures below 300 F; (3) forged "catalog" items; and (4) forgings shipped to affiliated plants or concerns.

MAJOR END-USE MARKETS

	1971		1976		1978		1980		1981	
	Ind. Sales $ Volume	% Of Sales	Ind. Sales $ Volume	% Of Sales	Ind. Sales $ Volume	% of Sales	Ind. Sales $ Volume	% Of Sales	Ind. Sales $ Volume	% Of Sales
1. Farm Machinery	36,780	4.0	93,601	5.5	106,218	4.9	116,985	4.6	121,071	4.2
2. Aircraft:										
Engines & Engine Parts	112,980	12.1	206,745	12.1	236,280	10.9	432,339	17.0	562,116	19.5
Aircraft, Parts & Auxiliary Eqpt.	92,065	9.9	184,973	10.8	234,112	10.8	439,969	17.3	495,815	17.2
Guided Missiles, Space Vehicles & Parts	21,662	2.3	22,457	1.3	30,348	1.4	27,975	1.1	31,709	1.1
3. Automotive:										
Passenger Cars & Parts	74,885	8.0	125,315	7.3	160,410	7.4	147,504	5.8	172,959	6.0
Trucks, Busses, Trailers & Related Parts	127,360	13.6	295,545	17.2	398,857	18.4	312,811	12.3	288,265	10.0
4. Internal Combustion Engine	14,379	1.4	25,029	1.5	28,180	1.3	41,866	1.6	51,888	1.8
5. Metalworking & Special Ind. (not mtlwrkg) Machinery	13,259	1.6	40,457	2.3	52,025	2.4	50,863	2.0	49,170	1.7
6. Mech. Power Transmission Eqpt. (incl. Bearings)	13,166	1.4	20,229	1.2	43,354	2.0	40,678	1.6	48,842	1.7
7. Nuclear	15,133	1.6	—	—	—	—	—	—	—	—
8. Fabricated Plate Work & Special Ind. Eqpt. not classified	—	—	17,657	1.0	21,677	1.0	17,802	0.7	23,061	0.8
9. Off-Highway Eqpt.	133,655	14.1	239,831	14.0	299,143	13.8	300,094	11.8	354,566	12.3
10. Ordnance (except missiles)	56,677	6.1	77,658	4.5	58,528	2.7	78,838	3.1	95,127	3.3
11. Oil Field Machinery & Eqpt.	16,714	1.8	42,686	2.5	62,836	2.9	89,001	3.5	129,719	4.5
12. Plumbing Fixtures, Valves & Fittings	32,587	3.5	78,001	4.6	95,379	4.4	86,468	3.4	98,010	3.4
13. Pumps & Compressors	15,126	1.6	8,742	0.5	13,006	0.6	25,432	1.0	25,943	0.9
14. Railroad Eqpt.	26,238	2.8	52,972	3.1	97,547	4.5	106,813	4.2	86,479	3.0
15. Refrigeration, Air Conditioning and Heat Eqpt.	9,337	1.0	21,600	1.2	15,147	0.7	17,802	0.7	14,413	0.5
16. Steam Engines & Turbines	15,406	1.7	28,972	1.7	41,186	1.9	39,529	1.6	43,240	1.5
17. Other	108,125	11.6	131,830	7.7	173,416	8.0	170,393	6.7	181,607	6.3
TOTALS	**933,734**	**100.0**	**1,714,300**	**100.0**	**2,167,703**	**100.0**	**2,543,173**	**100.0**	**2,882,648**	**100.0**

CLOSED IMPRESSION DIE				
Metal or alloy	1982 change (%)	1983 expectation (%)		
		Increase	Decrease	About the same
Carbon steel	+ 4.5	54.7	17.2	28.1
Common alloy steel	−10.8	64.8	13.0	22.2
Stainless steel	+ 8.7	52.2	13.0	34.8
Aluminum	+ 6.6	55.6	22.2	22.2
Titanium	−15.5	12.5	62.5	25.0
Brass & copper	− 6.8	42.9	14.3	42.9
Other nonferrous	−25.0	0.0	33.3	66.7
High-temperature	−12.6	33.3	41.7	25.0

Based on 75 responding plants

OPEN DIE				
Metal or alloy	1982 change (%)	1983 expectation (%)		
		Increase	Decrease	About the same
Carbon steel	−13.0	42.4	18.2	39.4
Common alloy steel	−10.6	36.0	24.0	40.0
Stainless steel	+ 3.6	52.9	17.7	29.4
Aluminum	+ 9.1	62.5	0.0	37.5
Titanium	−34.0	50.0	16.7	33.3
Brass & copper	− 3.4	25.0	0.0	75.0
Other nonferrous	0.0	0.0	0.0	100.0
High-temperature	+ 1.8	62.5	12.5	25.0

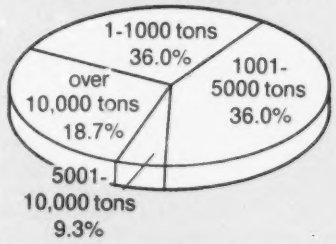
Based on 46 responding plants

OTHER (includes ring rolling, heading, upsetting and extrusion)				
Metal or alloy	1982 change (%)	1983 expectation (%)		
		Increase	Decrease	About the same
Carbon steel	+ 5.3	51.4	18.9	29.7
Common alloy steel	+24.1	62.5	9.4	28.1
Stainless steel	+36.7	63.6	0.0	36.4
Aluminum	− 2.8	55.6	22.2	22.2
Titanium	−33.1	66.7	11.1	22.2
Brass & copper	− 8.9	37.5	0.0	62.5
Other nonferrous	+50.0	16.7	16.7	27.7
High-temperature	− 6.2	62.5	0.0	37.5

Based on 50 responding plants
The 1982 change represents respondents' expected change in shipment poundage from 1981, expressed in percent.
The 1983 expectation columns give the percentage of respondents expecting 1983 shipments to increase, decrease or stay about the same as 1982.

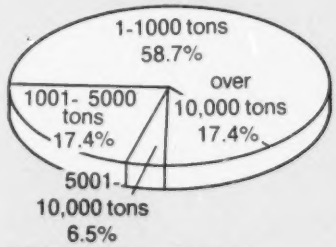
PLANT SIZE BREAKDOWN BY SHIPMENTS

CLOSED IMPRESSION DIE



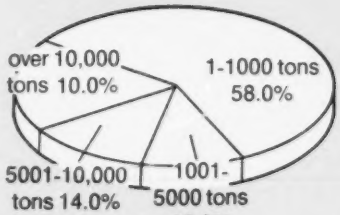
Based on 75 responding plants

OPEN DIE



Based on 46 responding plants

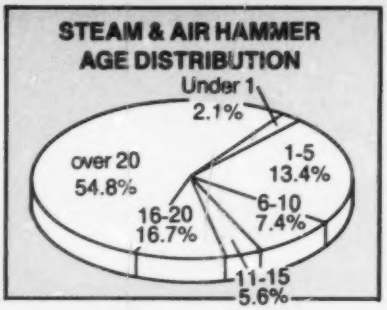
OTHER (INCLUDES RING ROLLING, HEADING, UPSETTING AND EXTRUSION)

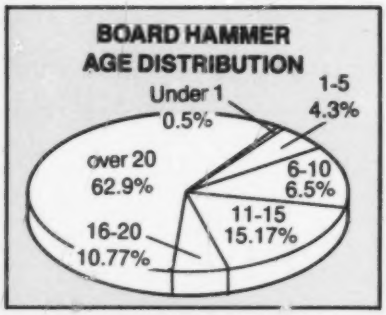


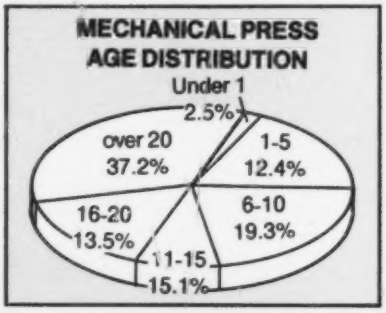
Based on 50 responding plants

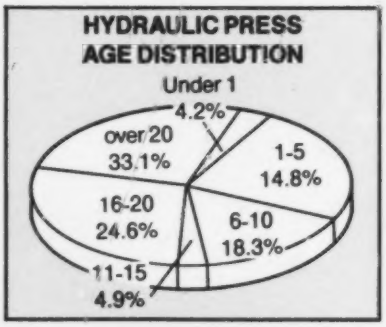
EXPENDABLE SUPPLIES				
Type	No. of plants	Respondents used	Average/ plant	Projected ind. total
Hot work die steel	77	6,135,768 lb	56,291 lb	50,000,000 lb
Die Lube (undiluted)	71	235,182 gal	2,158 gal	1,900,000 gal
Fire resistant hydraulic fluid	48	83,040 gal	762 gal	690,000 gal
Firebrick	64	401,106	3,680	3,300,000
Ceramic fiber insulation	47	120,635 ft^2	1,107 ft^2	1,000,000 ft^2
Blast cleaning supplies:				
Sand	19	191,950 lb	1,761 lb	1,600,000 lb
Shot	59	1,872,400 lb	17,178 lb	15,000,000 lb
Glass beads	14	110,250 lb	1,011 lb	910,000 lb
Abrasive wheels	54	50,344	462	420,000

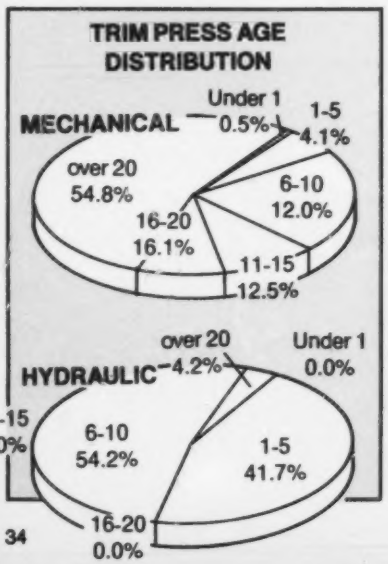
Based on 109 responding plants











STEAM & AIR HAMMERS

Size (pounds)	Now installed				Plan to buy by end 1983	
	No. of plants	No. of hammers	Average/ plant	Projected ind. total	No. of plants	No. of hammers
Less than 1000	5	13	0.1	70	0	0
1001-5000	59	268	1.7	1500	5	6
5001-10,000	27	59	0.4	330	2	2
10,001-25,000	15	38	0.2	210	2	3
over 25,000	4	8	0.1	50	0	0
Total	**70**	**386**	**2.4**	**2200**	**9**	**11**

Based on 160 responding plants

BOARD HAMMERS

Size (pounds)	Now installed				Plan to buy by end 1983	
	No. of plants	No. of hammers	Average/ plant	Projected ind. total	No. of plants	No. of hammers
Less than 1000	11	25	0.2	140	1	4
1001-5000	32	194	1.2	1100	4	12
5001-10,000	3	4	0.0	20	0	0
10,000-25,000	2	4	0.0	20	1	2
Total	**38**	**227**	**1.4**	**1300**	**5**	**18**

Based on 160 responding plants

MECHANICAL PRESSES

Size (tons)	Now installed				Plan to buy by end 1983	
	No. of plants	No. of presses	Average/ plant	Projected ind. total	No. of plants	No. of presses
100-500	30	155	1.0	870	4	6
501-1000	33	58	0.4	330	2	2
1001-2000	29	69	0.4	390	2	2
2001-5000	29	81	0.5	460	4	4
5001-10,000	6	9	0.1	50	2	3
over 10,000	2	2	0.0	10	0	0
Total	**76**	**374**	**2.3**	**2100**	**12**	**17**

Based on 160 responding plants

HYDRAULIC PRESSES

Size (tons)	Now installed				Plan to buy by end 1983	
	No. of plants	No. of presses	Average/ plant	Projected ind. total	No. of plants	No. of presses
100-500	21	72	0.5	410	4	8
501-1000	17	34	0.2	190	4	5
1001-2000	21	25	0.2	140	6	7
2001-5000	14	22	0.1	120	0	0
5001-10,000	4	4	0.0	20	0	0
over 10,000	5	5	0.0	30	0	0
Total	**54**	**162**	**1.0**	**910**	**12**	**20**

Based on 160 responding plants

TRIM PRESSES—MECHANICAL

Size (tons)	Now installed				Plan to buy by end 1983	
	No. of plants	No. of presses	Average/ plant	Projected ind. total	No. of plants	No. of presses
50-200	88	686	4.3	3900	8	13
201-300	28	134	0.8	750	3	3
301-400	17	47	0.3	260	1	1
over 400	18	36	0.2	200	1	8
Total	**96**	**903**	**5.6**	**5100**	**12**	**25**

Based on 160 responding plants

TRIM PRESSES—HYDRAULIC

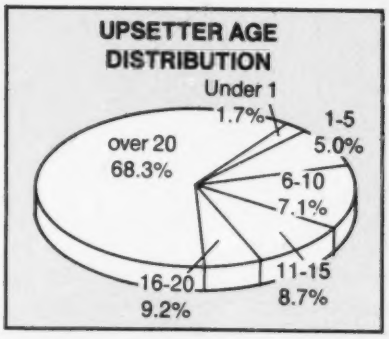
Size (tons)	Now installed				Plan to buy by end 1983	
	No. of plants	No. of presses	Average/ plant	Projected ind. total	No. of plants	No. of presses
50-200	3	4	0.0	20	0	0
201-300	3	12	0.1	70	0	0
301-400	1	1	0.0	10	0	0
over 400	2	5	0.0	30	0	0
Total	**8**	**22**	**0.1**	**120**	**0**	**0**

Based on 160 responding plants

UPSETTERS

Size (in.)	Now installed				Plan to buy by end 1983	
	No. of plants	No. of upsetters	Average/ plant	Projected ind. total	No. of plants	No. of upsetters
1/2	1	1	0.0	10	0	0
1	7	9	0.1	50	0	0
1-1/2	13	23	0.1	130	1	1
2	9	26	0.2	150	1	1
2-1/2	4	15	0.1	80	1	1
3-4	23	61	0.4	340	2	2
5-6	14	36	0.2	200	0	0
Total	**41**	**171**	**1.1**	**960**	**4**	**5**

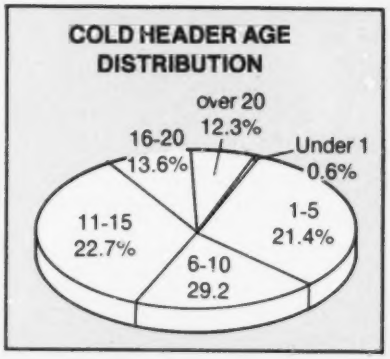
Based on 160 responding plants



COLD HEADERS

Size (in.)	Now installed				Plan to buy by end 1983	
	No. of plants	No. of headers	Average/ plant	Projected ind. total	No. of plants	No. of headers
1/8-1/4	8	100	0.6	560	0	0
1/4-1/2	15	56	0.4	320	3	4
1/2-3/4	12	26	0.2	150	3	6
3/4-1	3	6	0.0	30	0	0
over 1	3	5	0.0	30	0	0
Total	**22**	**193**	**1.2**	**1100**	**4**	**10**

Based on 160 responding plants



BAR & BILLET HEATERS—OIL FIRED

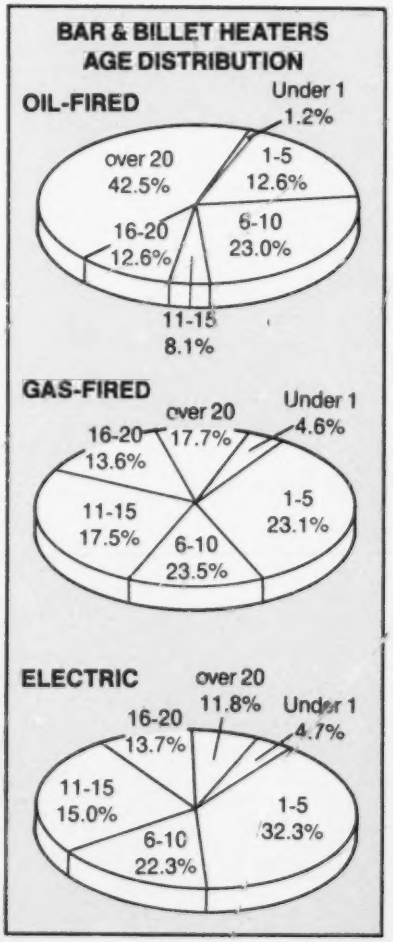
Type	Now installed				Plan to buy by end 1983	
	No. of plants	No. of heaters	Average/ plant	Projected ind. total	No. of plants	No. of heaters
Box	8	91	0.6	510	1	3
Rotary hearth	3	6	0.0	30	0	0
Slot	13	120	0.8	680	0	0
Pusher	1	1	0.0	10	0	0
Total	**21**	**218**	**1.4**	**1200**	**1**	**3**

Based on 160 responding plants

BAR & BILLET HEATERS—GAS FIRED

Type	Now installed				Plan to buy by end 1983	
	No. of plants	No. of heaters	Average/ plant	Projected ind. total	No. of plants	No. of heaters
Box	41	268	1.7	1500	8	17
Rotary hearth	13	26	0.2	150	0	0
Continuous belt	12	62	0.4	350	2	3
Slot	26	168	1.1	950	5	5
Pusher	7	21	0.1	120	2	4
Total	**77**	**545**	**3.4**	**3100**	**17**	**29**

Based on 160 responding plants



BAR & BILLET HEATERS—ELECTRIC

Type	Now installed				Plan to buy by end 1983	
	No. of plants	No. of heaters	Average/ plant	Projected ind. total	No. of plants	No. of heaters
Induction	67	347	2.2	2000	32	52
Resistance	21	106	0.7	600	4	12
Total	**79**	**453**	**2.8**	**2500**	**34**	**64**

Based on 160 responding plants

HEAT TREATING FURNACES

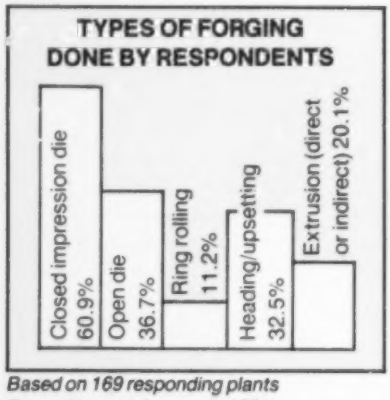
Type	Now installed				Plan to buy by end 1983	
	No. of plants	No. of furnaces	Average/ plant	Projected ind. total	No. of plants	No. of furnaces
Induction	22	67	0.4	380	5	5
Fuel-fired	90	407	2.5	2300	14	22
Total	**101**	**474**	**3.0**	**2700**	**18**	**27**

Based on 160 responding plants

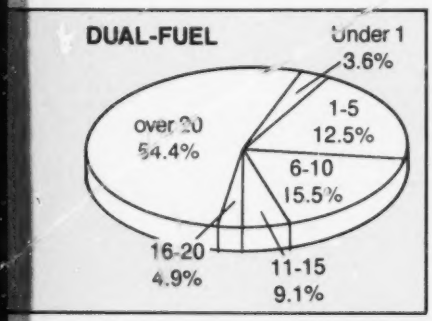
aircraft engines and engine parts, off-highway equipment, and oilfield machinery and equipment. (Oilfield machinery offers an interesting example of the pitfalls of prognostication. Last year, we predicted oilfield machinery would do well in the near future. The 1981 figures appear to bear this out. However, oil drilling has gone into a slump in recent months, and forging shipments to the industry have slipped.)

As in other industries, recovery for the forging industry depends on a healthy economy. Some markets, such as oilfield equipment, can be expected to rebound once temporary conditions (such as an oil glut) cease.

A serious hinderance to industry recovery is import penetration, which has increased dramatically in recent years. Some users have become convinced that superior quality and superior technology are offered by some foreign forgers (as well as the lower prices dervied from government subsidies). This contention is hotly disputed by many domestic forgers, some of which



Based on 169 responding plants
Percentage total exceeds 100% because some plants perform more than one type of forging.



BAR & BILLET HEATERS—DUAL FUEL

Type	Now installed				Plan to buy by end 1983	
	No. of plants	No. of heaters	Average/ plant	Projected ind. total	No. of plants	No. of heaters
Box	16	126	0.8	710	3	4
Rotary hearth	5	21	0.1	120	0	0
Continuous belt	1	2	0.0	10	0	0
Slot	23	160	1.0	900	1	3
Total	**32**	**309**	**1.9**	**1700**	**3**	**7**

Based on 160 responding plants

AUXILIARY EQUIPMENT

Type	Now installed				Plan to buy by end 1983	
	No. of plants	No. of machines	Average/ plant	Projected ind. total	No. of plants	No. of machines
Automatic lubricators	42	471	2.9	2600	6	15
Bar unscramblers	21	45	0.3	250	2	3
Billet saws	74	221	1.4	1200	7	5
Billet shears	74	190	1.2	1100	4	11
Blast cleaning equipment	90	233	1.5	1300	2	2
Conveyors	39	406	2.5	2300	10	28
Die making equipment:						
EDM	49	213	1.3	1200	6	8
Duplicating	45	122	0.8	690	6	7
Hobbing	5	5	0.0	30	0	0
N/C	23	61	0.4	340	4	0
Manipulators	28	147	0.9	830	4	5
P/M presses for preforms	10	43	0.3	240	1	2
Recuperators	19	88	0.6	500	10	31
Ring oilers	7	19	0.1	110	3	3
Robots	7	13	0.1	70	9	27
Sintering furnaces	8	33	0.2	190	2	5
Temperature instrumentation	77	663	4.1	3700	19	55
Process control systems:						
For instrumentation	38	212	1.3	1200	11	26
For forming equipment	11	50	0.3	280	5	11

Based on 160 responding plants

have very high technology of their own. Unless strong protectionism takes root in Washington, competition from imports is likely to become a permanent feature of the forging market.

The respondents to our survey were largely custom, with nearly 70% of their production for resale. Closed impression die forging is the most common type, with open die forging and heading or upsetting being performed by about one-third of our respondents. Most plants have fewer than 50 employees, but a few very large facilities raise the respondents' average to 86.8.

As in several other industries, our respondents are less optimistic than a year ago, particularly closed die producers.

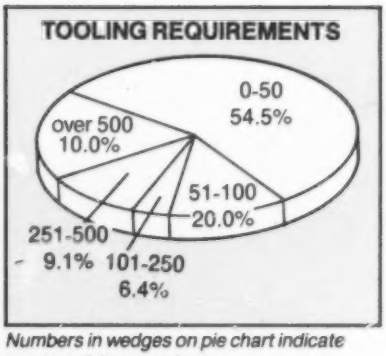
Buying plans for both hammers and presses are at a very low level. In recent years, the trend has been toward presses, particularly with the noise control problems associated with hammers. Much of the forming equipment in the industry is over 20 years old.

Upsetter and cold header buying plans are also at a very low level, in spite of the fact that the majority of installed upsetters are over 20 years old.

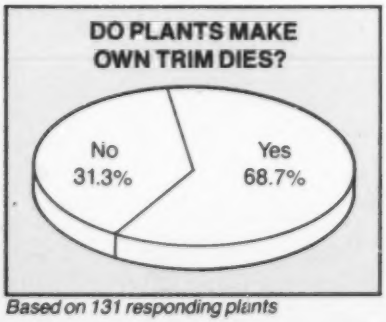
Electric heating equipment continues to be popular, especially induction heaters. Indeed, our respondents plan to buy more induction heaters than all other types combined. For the first time, we asked this year for the numbers of dual-fuel (gas or oil) furnaces installed. We found, to our surprise, more dual-fuel furnaces than purely oil-fired furnaces. Increasing oil prices have made the latter look unattractive to most forgers—only one respondent plans to buy any by the end of 1983.

Heat treating furnaces are predominately still fuel-fired. Buying plans appear to remain firm for recuperators which save fuel on furnaces by preheating combustion air. Most process control systems are installed on furnaces. Robots have not made significant penetration into forging plants yet. Most plants make their own forging and trim dies.

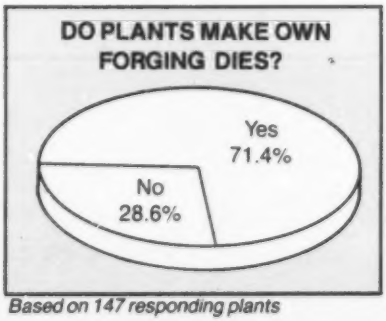
Projections for expendable supplies were made by taking the known custon impression die shipments (from FIA) and dividing this by respondents' custom closed die shipments. This ratio was then multiplied by respondents' expendable supplies totals to project industry totals.



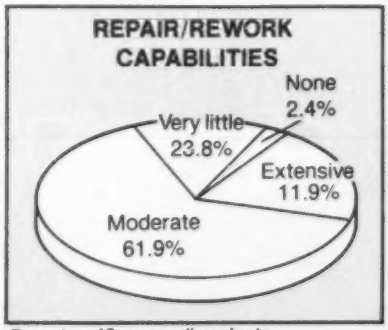
Numbers in wedges on pie chart indicate number of dies per plant
Based on 110 responding plants
Total: 33,740 new dies
Average per plant: 307
Projected industry total: 280,000 new dies in 1981



Based on 131 responding plants



Based on 147 responding plants



Based on 42 responding plants
These are repair/rework capabilities of plants that do not make their own trim dies.

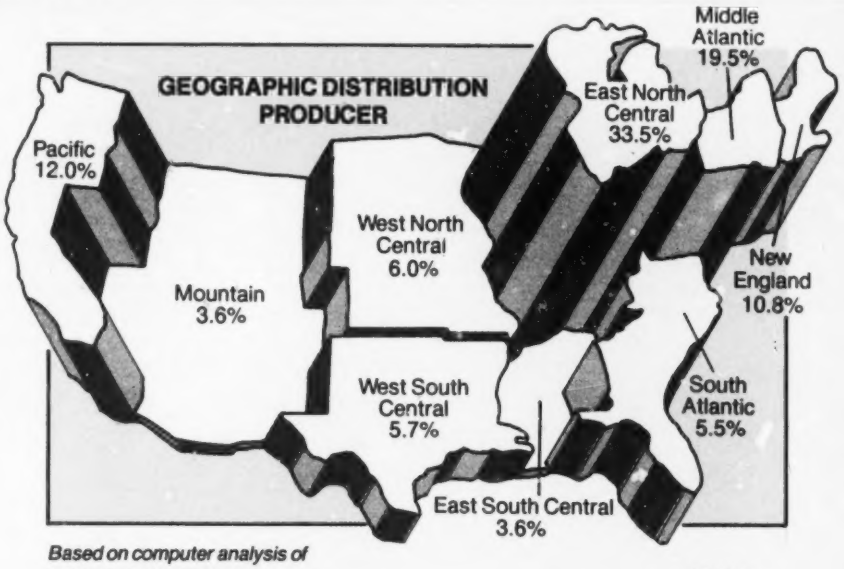
INVESTMENT CASTING

STATE OF THE INDUSTRY

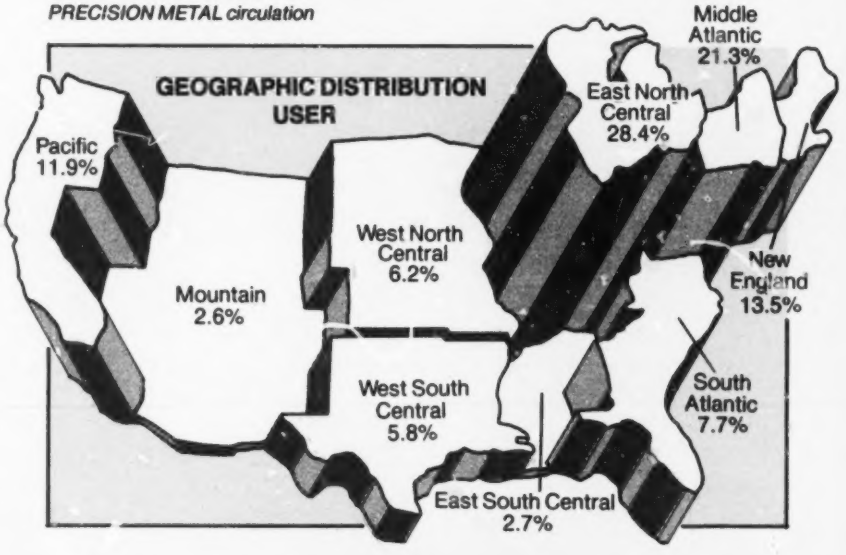
Questionnaires were sent to 959 management and production executives in the investment casting industry. A total of 92 usable responses was received, for a response rate of 8.6%. We assumed an industry size of 300 plants to project industry totals.

Investment casting output is primarily custom, over 70% so from this years' respondents. Due to the many steps involved in producing an investment casting, investment casters have more employees per plant than plants in some other precision metal industries.

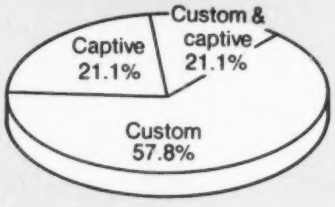
Like most industries, investment casting is feeling the pinch of the recession.



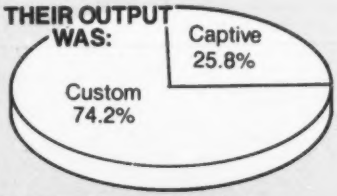
Based on computer analysis of PRECISION METAL circulation



THE RESPONDENTS TO OUR INVESTMENT CASTING SURVEY WERE:

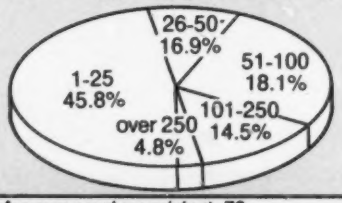


THEIR OUTPUT WAS:



Based on 90 responding plants

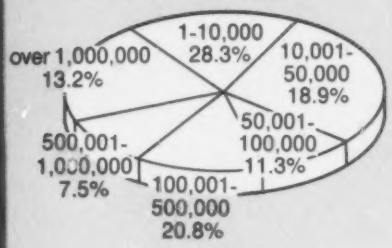
PLANT SIZE BREAKDOWN BY NUMBER OF EMPLOYEES
(investment casting operation only)



Average employees/plant: 79
Based on 83 responding plants

SHIPMENTS (1981)			
Metal or alloy	Number of plants	Respondents shipped (lb)	Projected ind. total (lb)
Aluminum	22	2,410,020	14,000,000
Copper	16	346,162	2 000,000
Titanium	1	1000	6000
Low carbon steel	15	4,742,200	27,000,000
High carbon steel	10	538,530	3,000,000
Low alloy steel	13	3,283,500	19,000,000
High alloy steel	16	1,577,400	8,900,000
Stainless steel	27	8,028,400	45,000,000
Superalloys	12	312,710	1,800,000
High temperature alloys	11	842,400	4,800,00
Total	**53**	**22,082,322**	**130,000,000**

PLANT SIZE BREAKDOWN BY SHIPMENTS



Weights are expressed in pounds
Based on 53 responding plants

SHIPMENT TRENDS

Metal or alloy	1982 change (%)	1983 expectation (%) Increase	Decrease	About the same
Aluminum	+4.7	62.1	6.9	31.0
Copper	+14.0	31.8	4.6	63.6
Titanium	0.0	60.0	20.0	20.0
Low carbon steel	+9.8	33.3	27.8	38.9
High carbon steel	+5.4	41.7	25.0	33.3
Low alloy steel	+5.1	43.7	12.5	43.7
High alloy steel	+10.5	44.4	5.6	50.0
Stainless steel	+17.2	51.5	15.2	33.3
Superalloys	−4.5	57.9	10.5	31.6
High temperature alloys	+44.9	46.7	13.3	40.0

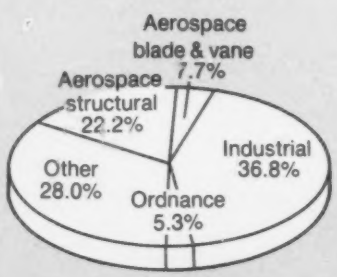
Based on 53 responding plants
The 1982 change column represents respondents' expected change in shipment poundage from 1981, expressed in percent.
The 1983 expectation columns give the percentages of respondents expecting 1983 shipments to increase, decrease or stay about the same as 1982.

CAPITAL EQUIPMENT

Type	Now installed: Number of plants	Number of machines	Average/ plant	Projected ind. total	Plan to buy by end 1983: Number of plants	Number of machines
Autoclaves	51	81	1.1	340	15	15
Blast cleaning equipment	67	231	3.2	960	15	27
Burnout furnaces	67	278	3.9	1200	17	37
Dipping equipment (automatic)	21	50	0.7	210	12	25
Fluidized beds	45	209	2.9	870	14	32
Furnace controls	55	315	4.4	1300	9	52
Heat treating furnaces	46	148	2.1	620	13	25
Melting furnaces	72	260	3.6	1100	13	26
Microwave dewaxers	4	15	0.2	60	1	1
Molten metal furnaces	23	62	0.9	260	3	4
Plastic molding machines	14	44	0.6	180	4	5
Robots	17	33	0.5	140	11	17
Slurry mixers	59	293	4.1	1200	13	35
Stucco units	31	102	1.4	430	9	17
Vacuum casting equipment	25	62	0.9	260	3	7
Vibration tables	26	64	0.9	270	3	3
Wax extruders	24	60	0.8	250	7	10
Wax injectors	62	493	6.8	2100	20	58

Based on 72 responding plants

END-USE MARKETS



Based on 83 responsing plants

EXPENDABLE SUPPLIES

Type	Number of plants	Respondents used	Average/ plant	Projected ind. total
Sand	32	649,925 lb	13,540 lb	4,100,000 lb
Shot	22	348,410 lb	7,259 lb	2,200,000 lb
Grit	21	299,000 lb	6,229 lb	1,900,000 lb
Glass beads	21	91,905 lb	1,915 lb	570,000 lb
Crusibles	48	20,180	420	130,000
Cut-off wheels	40	67,643	1,409	420,000
Grinding wheels	35	40,807	850	260,000
Investment binders	38	588,873 gal	12,268 gal	4,600,000 gal
Investment materials	45	9,056,900 lb	188,685 lb	60,000,000 lb
Pattern wax	45	2,752,334 lb	57,340 lb	18,000,000 lb
Precoat materials	18	1,721,900 lb	35,873 lb	11,000,000 lb
Preformed cores	18	150,650	3,139	940,000

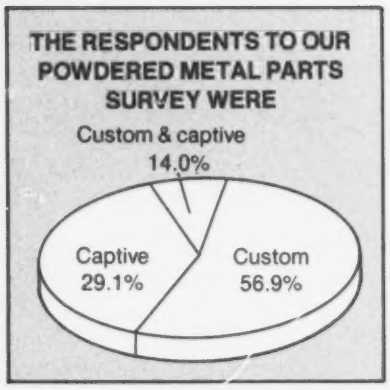
Based on 48 responding plants
It was assumed that all plants used investment binders, investment materials and pattern wax.

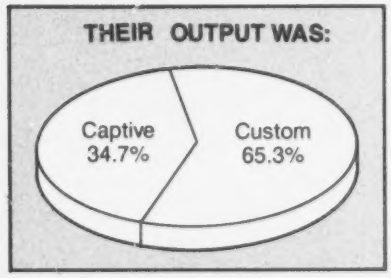
POWDER METALLURGY STATE OF THE INDUSTRY

Questionnaires were sent to 1051 management and production executives in the powder metal parts industry. We received 93 usable returns for a response rate of 8.8%. Projected industry totals were made over an estimated industry size of 300 plants.

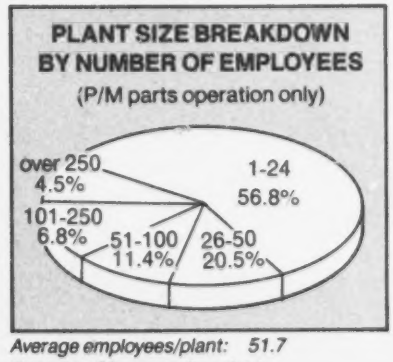
The respondents to our P/M parts survey were largely custom, with nearly two-thirds of their output for resale. Most plants have 50 or fewer employees.

Iron-base parts constitute the greatest fraction of P/M parts production. Iron powder production for P/M parts was up slightly in 1981 according to the

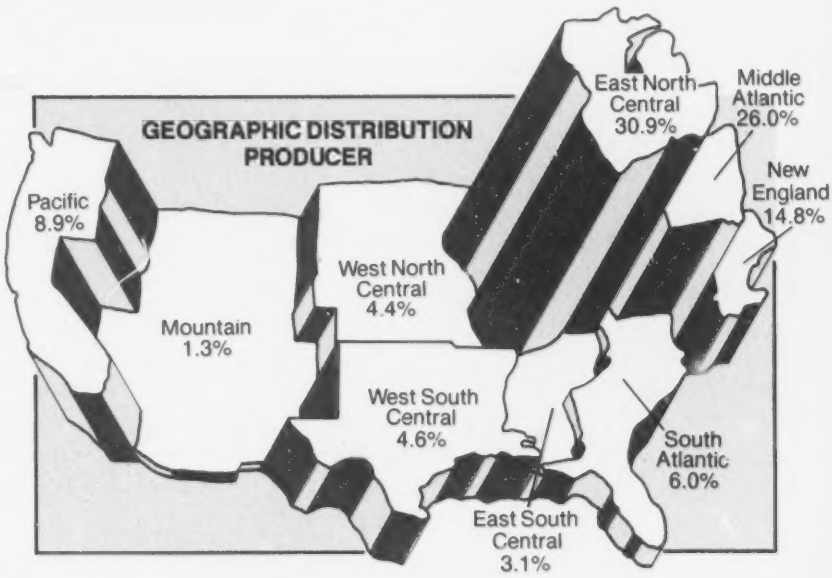




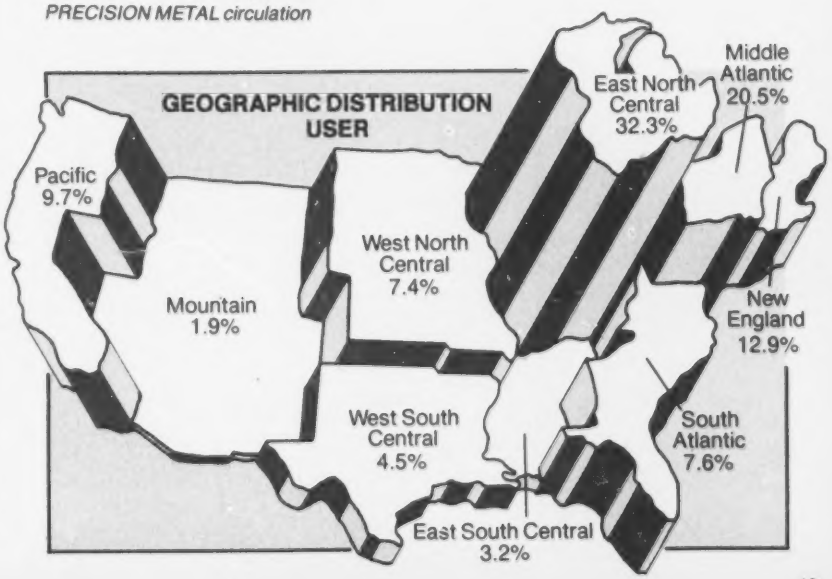
Based on 93 responding plants

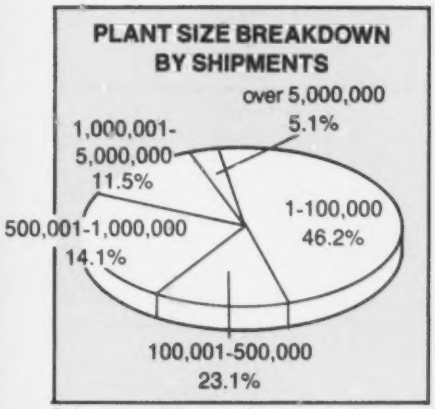


Average employees/plant: 51.7
Based on 88 responding plants



Based on computer analysis of PRECISION METAL circulation





Shipment weights are given in pounds
Based on 78 responding plants

Metal Powder Industries Federation. Copper and tungsten powder production were also up in 1981, while most other powders declined slightly. This continues the stagnation in the industry in recent years—a distinct change from the 1950's and 1960's when powder metallurgy had a high growth rate. The pessimism about the near future evident in other industries also appears here. Again, it must be emphasized that our respondents are normally optimistic about the future.

Mechanical presses make up most of the industry's installed capacity, but, as noted in the past, hydraulic presses are becoming increasingly popular. Buying plans here are also down noticeably Isostatic presses are still rare.

The majority of sintering furnaces are electric. Continous furnaces outnumber batch units, largely because there are

SHIPMENTS (1981)

Metal or alloy	No. of plants	Respondents shipped (lb)	Projected ind. total (lb)
Aluminum	5	6,350	24,000
Brass	18	575,616	2,200,000
Bronze	23	7,576,071	24,000,000
Copper	4	4,238,000	13,000,000
Iron or steel	40	60,842,180	260,000,000
Stainless steel	24	1,427,221	5,500,000
Tungsten carbide	10	2,273,100	7,000,000
Others	22	685,790	2,600,000
Total	**78**	**77,624,328**	**300,000,000**

SHIPMENT TRENDS

Metal or Alloy	1982 change (%)	1983 expectation (%)		
		Increase	Decrease	About the same
Aluminum	+15.0	30.8	7.7	61.5
Brass	+ 7.1	41.7	12.5	45.8
Bronze	− 3.9	28.6	21.4	50.0
Copper	−19.1	25.0	—	75.0
Iron or steel	− 0.6	65.9	13.6	20.5
Stainless steel	−10.4	50.0	19.2	30.8
Tungsten carbide	− 3.9	50.0	20.0	30.0

Based on 71 responding plants

METAL POWDER SHIPMENTS (In Short tons)

	Iron Powder (P/M parts Only)	Iron Powder (Total)	Copper and Copper Base (Granular)	Aluminum (Atomized Granular)
1973 Total	151,498	194,480	29,449	103,060
1975 Total	104,692	140,375	19,414	34,310
1977 Total	158,704	199,393	28,510	45,449
1979 Total	158,091	199,043	30,935	45,505
1981 Total	133,772	174,374	22,041	39,831

	MOLYB-DENUM	TUNGSTEN (Hydrogen Reduced)	TUNGSTEN (Carbide Powder)	NICKEL (Powder & Flake)	TIN (Powder)
1973 Total	1,823	2,909	3,444	7,647	1,579
1975 Total	1,065	2,723	3,510	10,034	932
1977 Total	2,150	3,135	2,925	13,759	1,416
1979 Total	2,475	1,851	3,946	16,965	1,445
1981 Total	1,803	2,095	3,846	14,127	995

NOTE: Iron powder includes iron-base alloys but not stainless alloys and represents U.S.A. as well as Canadian shipments for consumption within these countries. All other powders are U.S.A. shipments for domestic consumption. Nickel powders include flake and are based on imports. Tin powder includes both primary and secondary sources.

LUBRICANTS

Type	No. of plants	Respondents used (lb)	Projected ind. total (lb)
Graphite	36	330,120	1,700,000
Lithium stearate	15	10,315	52,000
Zinc stearate	28	252,722	1,300,000
Stearic acid	10	7,950	40,000
Wax	33	144,541	720,000
Total	**60**	**745,648**	**3,700,000**

MECHANICAL COMPACTING PRESSES

	Now installed				Plan to buy by end 1983	
Size (tons)	No. of plants	No. of presses	Average/ plant	Projected ind. total	No. of plants	No. of presses
Under 20	50	283	3.3	980	11	15
20-40	37	196	2.3	680	4	10
41-80	35	114	1.3	390	6	9
81-100	23	44	0.5	150	3	3
101-200	17	62	0.7	210	2	2
over 200	17	42	0.5	150	5	6
Total	**67**	**741**	**8.5**	**2600**	**23**	**45**

Based on 87 responding plants

HYDRAULIC COMPACTING PRESSES

	Now installed				Plan to buy by end 1983	
Size (tons)	No. of plants	No. of presses	Average/ plant	Projected ind. total	No. of plants	No. of presses
Under 20	13	34	0.4	120	4	4
20-40	11	22	0.3	80	2	5
41-80	15	29	0.3	100	6	7
81-100	15	27	0.3	90	1	2
101-200	16	28	0.3	100	3	3
over 200	14	42	0.5	150	4	4
Total	**51**	**182**	**2.1**	**630**	**17**	**25**

Based on 87 responding plants

ISOSTATIC PRESSES

	Now installed				Plan to buy by end 1983	
Size (tons)	No. of plants	No. of presses	Average/ plant	Projected ind. total	No. of plants	No. of presses
Under 20	5	6	0.1	20	2	2
20-40	6	9	0.1	30	2	2
41-80	—	—	—	—	—	—
81-100	1	1	—	10	—	—
101-200	—	—	—	—	—	—
over 200	1	1	—	10	—	—
Total	**12**	**17**	**0.2**	**60**	**4**	**4**

Based on 87 responding plants

COINING PRESSES

	Now installed				Plan to buy by end 1983	
Size (tons)	No. of plants	No. of presses	Average/ plant	Projected ind. total	No. of plants	No. of presses
Under 20	21	116	1.3	400	3	7
20-40	20	63	0.7	220	1	1
41-80	21	68	0.8	230	3	4
81-100	5	10	0.1	30	4	5
101-200	9	49	0.6	170	1	1
over 200	11	25	0.3	90	3	4
Total	**42**	**331**	**3.8**	**1100**	**9**	**22**

Based on 87 responding plants

SINTERING FURNACES

	Now installed				Plan to buy by end 1983	
Type	No. of plants	No. of furnaces	Average/ plant	Projected ind. total	No. of plants	No. of furnaces
Continuous electric	50	194	2.2	670	10	15
Continuous fuel	27	78	0.9	270	6	8
Batch electric	37	205	2.4	710	10	22
Batch fuel	8	11	0.1	40	—	—
Total	**84**	**488**	**5.6**	**1700**	**26**	**45**

Based on 87 responding plants

HEAT TREATING FURNACES

	Now installed				Plan to buy by end 1983	
Type	No. of plants	No. of furnaces	Average/ plant	Projected ind. total	No. of plants	No. of furnaces
Continuous electric	13	33	0.4	110	1	1
Continuous fuel	5	11	0.1	40	1	3
Batch electric	20	44	0.5	150	2	5
Batch fuel	11	21	0.2	70	—	—
Total	**42**	**109**	**1.3**	**380**	**4**	**9**

Based on 87 responding plants

ATMOSPHERE GENERATORS						
	Now installed				Plan to buy by end 1983	
Type	No. of plants	No. of machines	Average/ plant	Projected ind. total	No. of plants	No. of machines
Hydrogen	9	13	0.2	60	1	1
Dissociated ammonia	34	50	0.7	210	8	8
Endothermic	32	67	0.9	280	—	—
Exothermic	6	7	0.1	30	2	2
Nitrogen	17	31	0.4	130	5	7
Total	**65**	**108**	**2.4**	**710**	**15**	**18**

Based on 71 responding plants

AUXILIARY EQUIPMENT						
	Now installed				Plan to buy by end 1983	
Type	No. of plants	No. of machines	Average/ plant	Projected ind. total	No. of plants	No. of machines
Hopper feeders	43	201	2.3	700	13	29
EDM machines	24	38	0.4	130	3	3
Powder blenders	66	160	1.9	560	7	10
Impregnating equipment	33	63	0.7	220	1	1
Furnace controls	48	271	3.2	950	9	34

Based on 86 responding plants

few fuel-fired batch units. Electric furnaces are also more popular for heat treating, although batch units outnumber continuous units in this application.

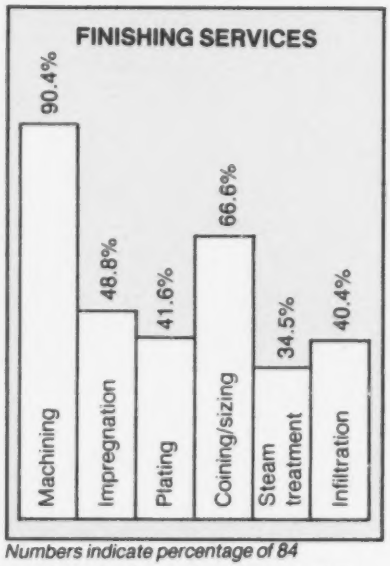
Endothermic atmosphere generators are the most common type, followed by dissociated ammonia and nitrogen units. There seems to be a trend toward nitrogen-type units.

Most of our respondents have some sort of secondary operation available, with machining offered by over 90% of our respondents. Coining is also offered by most plants.

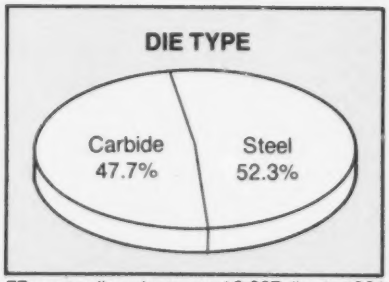
Over two-thirds of our respondents use outside die makers. Slightly more than half of our respondents use steel dies—a marked change from last year when most used carbide dies. We think the difference from last year's results is due to a different sample population, not to a sudden shift in die material.

OTHER SUPPLIES				
Type	No. of plants	Respondents used (1981)	Average/ plant	Projected ind. total
Atmosphere	37	337,916,000 ft3	9,132,865 ft3	1,500,000,000 ft3
Furnace belts	38	148	3.9	670
Sintering trays	35	5,111	146.0	23,000

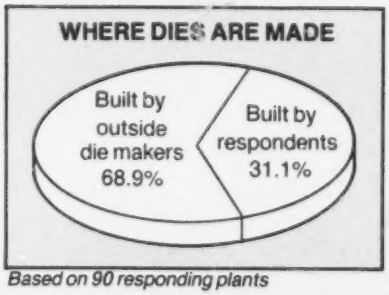
Based on 66 responding plants



Numbers indicate percentage of 84 respondents that performs given service.



77 responding plants used 2,887 dies in 1981.
Average/plant: 37.5
Projected industry total: 11,000

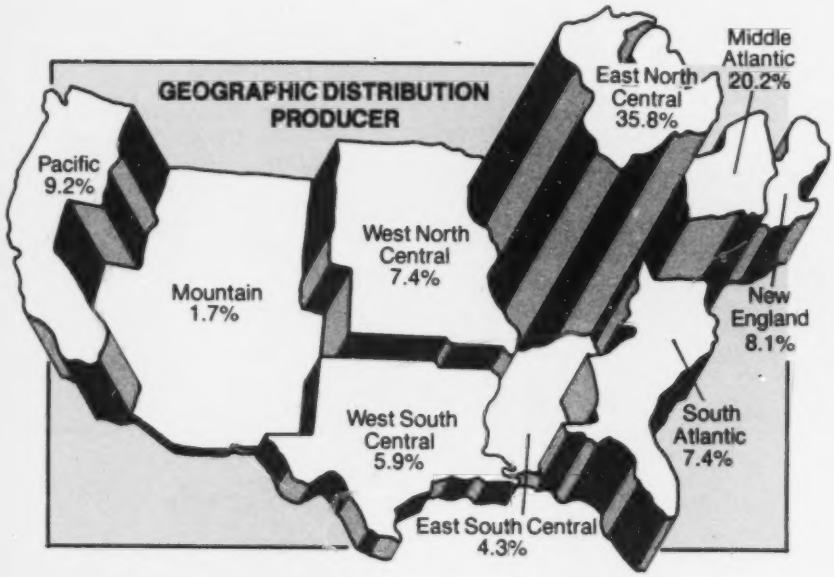


Based on 90 responding plants

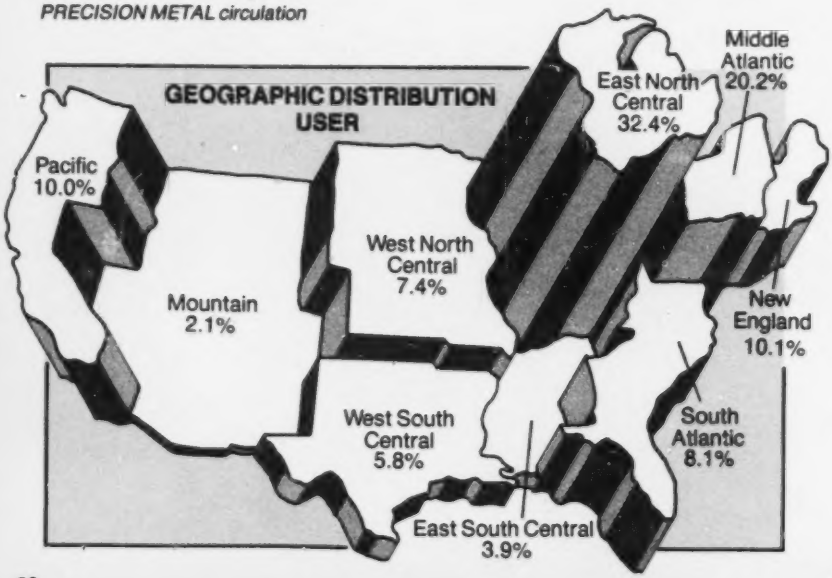
ROLL FORMING STATE OF THE INDUSTRY

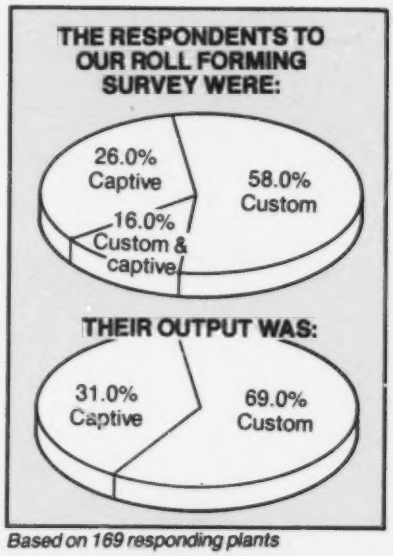
Questionnaires were sent to 3106 management and production executives in the roll forming and tubemaking industries. A total of 207 usable responses were received for a response rate of 6.7%. Projections for industry totals were based on a projected industry size of 1800 plants.

Our roll forming rspondents were primarily custom, with nearly 70% of their output for resale. However, we suspect that the captive segment of the industry is much larger than the response to our survey would indicate. Tubemaking re-

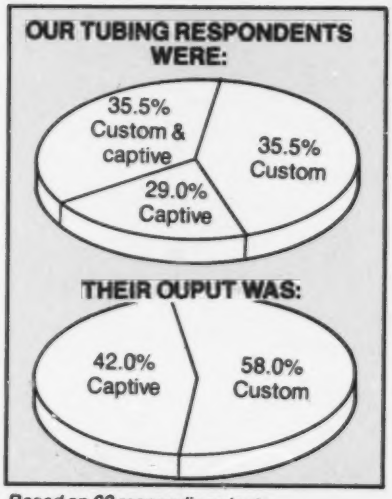


Based on computer analysis of PRECISION METAL circulation

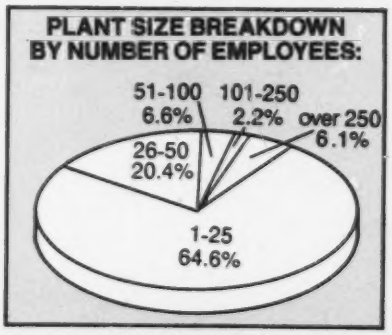




Based on 169 responding plants



Based on 62 responding plants



Average employees/plant: 68.5
Based on 181 responding plants

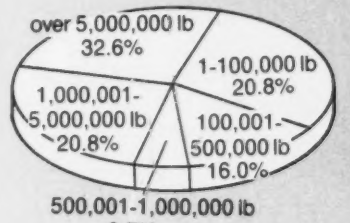
SHIPMENTS (1981)					SHIPMENT TRENDS			
Metal or alloy	No. of plants	Respondents shipped (lb)	Average/ plant (lb)	Projected ind. total (lb)	1982 Change (%)	1983 expectation (%) Increase	Decrease	About the same
Aluminum	34	79,112,000	549,389	990,000,000	− 2.2	42.4	12.1	45.5
Brass	8	352,427	2,447	4,400,000	−15.5	33.3	11.1	55.6
Copper	7	6,772,150	47,029	85,000,000	− 4.1	42.9	28.6	28.5
Laminated strip	7	9,633,450	66,899	120,000,000	−59.5	71.4	0.0	28.6
Prefinished strip	5	2,577,424	17,899	32,000,000	− 1.5	80.0	0.0	20.0
Prepainted strip	19	175,114,000	1,216,069	2,200,000,000	−21.8	63.2	5.2	31.6
Preplated strip	9	22,567,940	156,722	280,000,000	+ 3.9	50.0	30.0	20.0
Steel, carbon	61	542,079,000	3,764,440	6,800,000,000	− 5.4	39.3	14.7	46.0
Steel, galvanized	49	274,952,000	1,909,390	3,400,000,000	−12.3	50.0	22.9	27.1
Steel, high strength low alloy	15	94,654,126	657,320	1,200,000,000	+13.2	57.1	21.4	21.4
Steel, stainless	31	18,255,000	126,771	230,000,000	+ 5.8	58.1	12.9	29.0
Vinyl clad strip	3	693,261	4,814	8,700,000	−18.8	33.3	33.3	33.3
Other	12	19,898,400	138,183	250,000,000				
Total	**144**	**1,326,662,328**	**9,212,900**	**17,000,000,000**				

Based on 144 responding plants

ROLL FORMERS & TUBE MILLS						
	Now Installed				Plan to buy by end 1983	
	No. of plants	No. of machines	Average/ plant	Projected ind. total	No. of plants	No. of machines
Roll formers	162	1,054	5.5	9,900	49	136
Tube mills	43	181	0.9	1,700	11	21

Based on 192 responding plants

PLANT SIZE BREAKDOWN BY SHIPMENTS



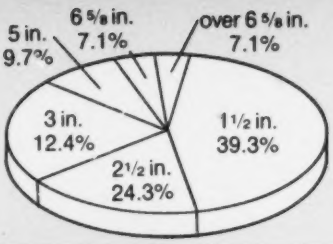
Based on 144 responding plants

AUXILIARY EQUIPMENT						
	Now installed				Plan to buy by end 1983	
	No. of plants	No.of machines	Average/ plant	Projected ind. total	No. of plants	No. of machines
Coil cars	37	85	0.5	890	4	4
Coil coaters	15	32	0.2	330	0	0
Coil lifters	68	219	1.3	2,300	2	2
Coil tippers	27	50	0.3	520	2	2
Conveyors, pre-cut stock	34	115	0.7	1,200	6	6
Cut-off equipment	130	892	5.2	9,300	17	25
Edge finishers	35	173	1.0	1,800	3	5
Embossing machines	17	39	0.2	410	2	2
Forming presses	66	453	2.6	4,700	5	15
Jib cranes	74	258	1.5	2,700	6	17
Lubricators	53	306	1.8	3,200	9	15
Power shears	97	423	2.4	4,400	7	15
Press brakes	94	644	3.7	6,700	2	4
Punching/notching presses	118	1,312	7.6	14,000	11	21
Reels, uncoilers	117	983	5.7	10,000	13	24
Slitters	55	144	0.8	1,500	2	7
Stackers, pre-cut stock	21	83	0.5	860	3	7
Stock straighteners	74	435	2.5	4,500	7	7
Strip accumulators	24	81	0.5	840	2	3
Strip polishers	8	44	0.3	460	2	2
Uncoilers	55	350	2.0	3,600	7	17
Welders, coil end	57	236	1.4	2,500	6	11
Welders, seam	39	143	0.8	1,500	6	10
Wing formers	13	30	0.2	310	2	4

Based on 173 responding plants

TUBE MILL BREAKDOWN BY MAXIMUM O.D.

Based on 72 responding plants



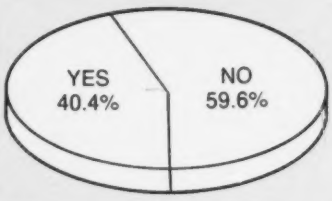
EXPENDABLE SUPPLIES				
Type	No. of plants	Respondents used	Average/ plant	Projected ind. total
Coil coating materials	14	233,700 gal	2,782 gal	5,000,000 gal
Lubricants	75	53,188 gal	633 gal	1,100,000 gal

Based on 84 responding plants

ROLL SETS (New in 1981)				
Type	No. of plants	Respondents used	Average/ plant	Projected ind. total
Roll forming	104	944	7.1	13,000
Tubemaking	29	234	1.8	3,200
Reground rolls	120	1372	10.3	19,000

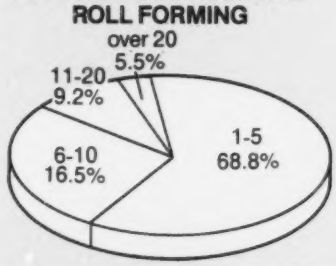
Based on 133 responding plants

DO PLANTS MAKE OWN ROLLS



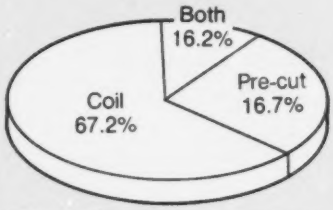
Based on 198 responding plants

TOOLING REQUIREMENTS- ROLL FORMING



Based on 109 responding plants

FORM IN WHICH METALS ARE USED



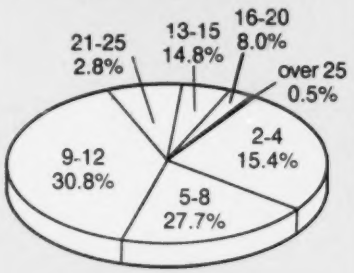
Based on 198 responding plants

SOURCES FOR METALS

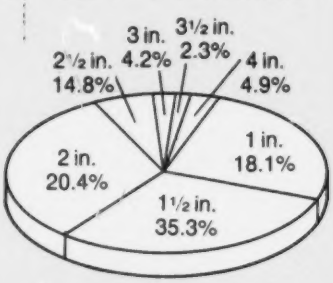
Based on 154 responding plants

ROLL FORMING MACHINE BREAKDOWN

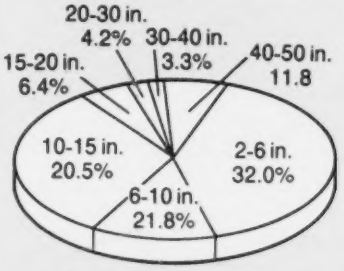
BY NUMBER OF ROLLSTANDS



BY ROLL SHAFT DIAMETER

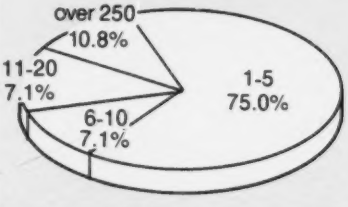


BY MAXIMUM STRIP WIDTH



Based on 179 responding plants

TOOLING REQUIREMENTS- TUBEMAKING



Based on 28 responding plants

END-USE INDUSTRIES

Sporting goods	1.4%
Transportation	14.1%
Construction/building products	38.9%
Furniture & office equipment	10.3%
Appliances	8.2%
Aerospace	3.7%
Other	23.4%

Based on 184 responding plants

sponses were slightly more custom than captive.

Most roll forming and tubemaking operations employ 25 or fewer people. A small number of large operations pushed the average number of employees to a much higher figure.

Carbon steel is easily the most widely roll formed material, followed by galvanized steel and prepainted strip. Our respondents expect decreases in most metals in 1982. This is one industry where, judging by the replies we received, there seems to be more optimism for the coming year than there was a year ago.

Most rolls are purchased from outside roll makers. More rolls are reground than are purchased new each year. Metals are largely used in coil rather than pre-cut form. The most common sources for the metals are steel service centers and the mills (pre-slit coil).

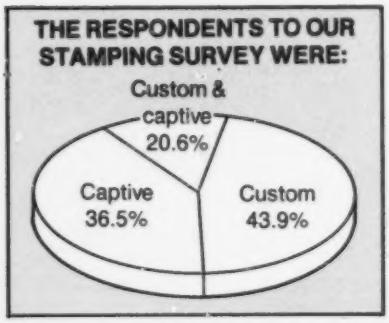
Construction/building products is the largest end-use industry by far. Transportation and furniture and office equipment are other significant markets.

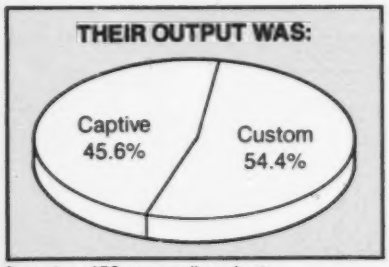
STATE OF THE STAMPING INDUSTRY

Questionnaires were sent to 5137 management and production executives in the stamping industry. A total of 523 usable responses were received, for a response rate of 10.2%. The total number of stamping operations in the United States is assumed to be 10,000, based on data from the *1977 Census of Manufacturers*.

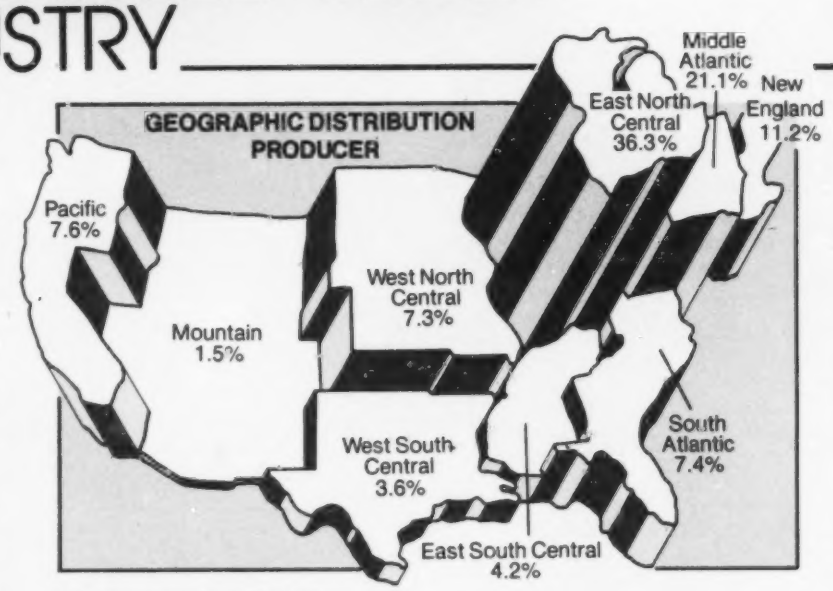
Although our respondents were somewhat more custom than captive, more than 80% of the stamping facilities in the United States are captive, according to the 1977 census.

Progressive die and short run operations were the stamping types report-

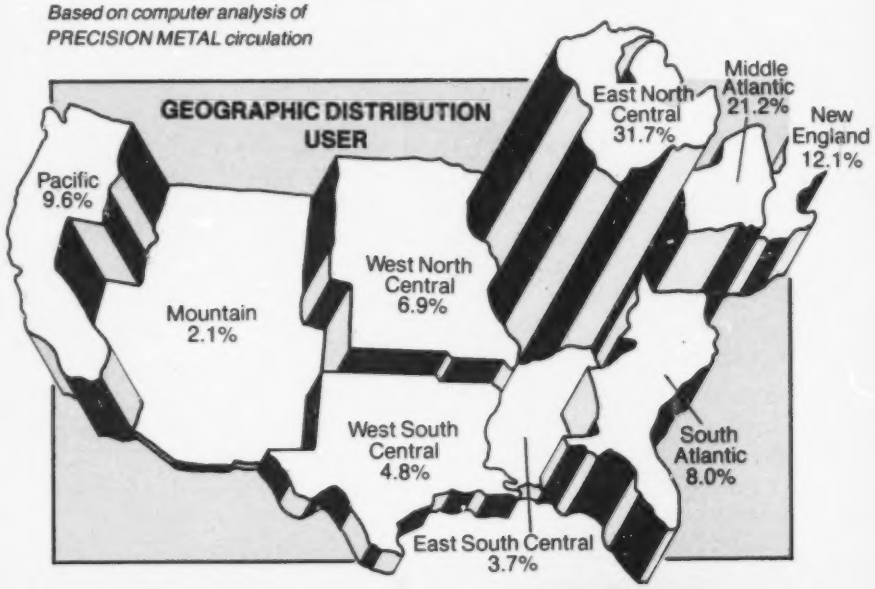


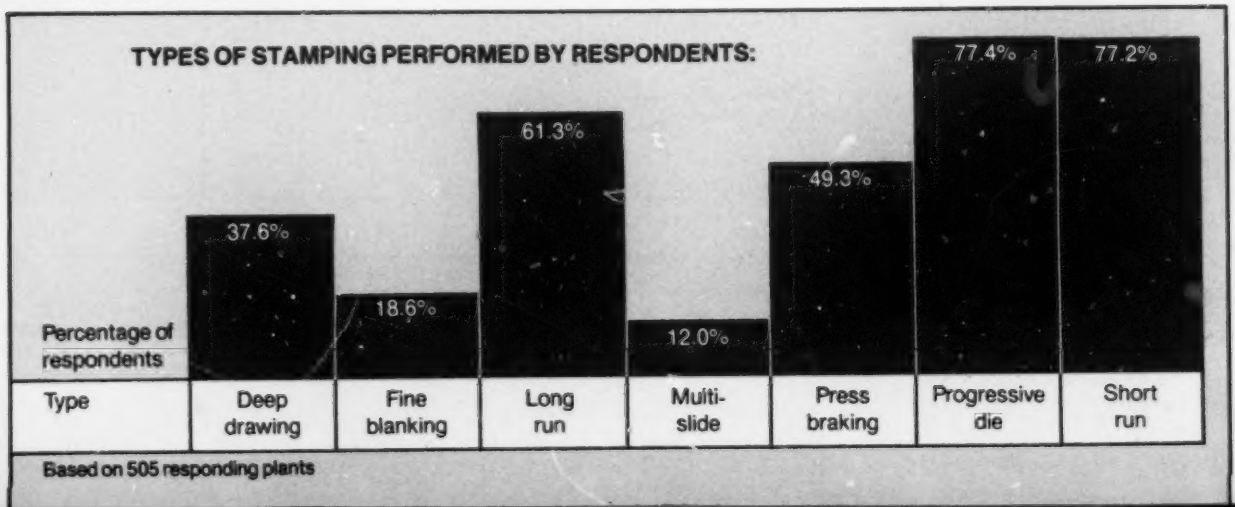


Based on 458 responding plants



Based on computer analysis of PRECISION METAL circulation





Based on 505 responding plants

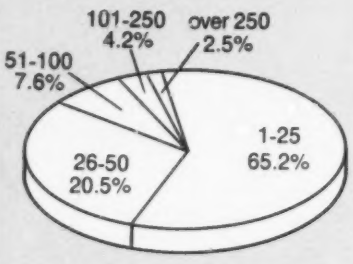
ed most frequently by our respondents. Long run stamping is also performed by more than half our respondents.

Stamping operations tend to be small, with nearly two-thirds employing 25 or fewer people. Stamping may exhibit the widest range in operation size of the precision metal industries; from small captive operations with only one press to huge custom and captive operations with hundreds of presses. Stamping is the most pervasive of the precision metal industries, and has the largest shipment weights.

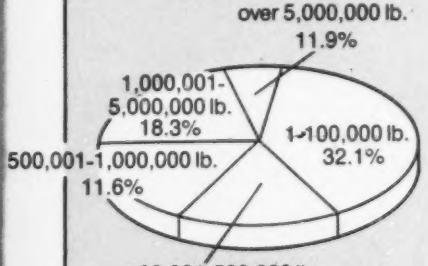
By far the most commonly stamped material is carbon steel; galvanized steel is a distant second. Our respondents expect decreases in most metals in 1982. In every metal, the greatest number of respondents expect 1983 shipments to be about the same as 1982 shipments.

Most stamping presses are mechanical, as are most of the presses our

PLANT SIZE BREAKDOWN BY NUMBER OF EMPLOYEES
(stamping operation only)



PLANT SIZE BREAKDOWN BY SHIPMENTS



Based on 327 responding plants

FORM IN WHICH METALS ARE USED

Pre-cut:	58.3%
Coil:	78.2%

Percentages of responding plants
Based on 487 responding plants

SHIPMENTS (1981)

Metal or alloy	No. of plants	Respondents shipped (lb)	Projected ind. total (lb)
Aluminum	159	36,754,545	1,100,000,000
Beryllium copper	41	539,578	17,000,000
Brass	102	10,689,327	330,000,000
Bronze	29	2,236,778	68,000,000
Copper	53	6,378,570	200,000,000
Nickel	24	3,406,240	100,000,000
Alloy steel	74	38,031,000	1,200,000,000
Carbon steel	223	583,463,265	18,000,000,000
Galvanized steel	77	69,956,695	2,100,000,000
Polished steel	16	256,100	7,800,000
Pre-finished steel	20	11,740,650	360,000,000
Stainless steel	171	38,658,524	1,200,000,000
Terne plate	20	2,137,500	65,000,000
Tin plate	20	33,837,050	1,000,000,000
Other	33	5,742,202	180,000,000
Total	**327**	**843,828,024**	**16,000,000,000**

SHIPMENT TRENDS

Metal or alloy	1982 change (%)	1983 expectation (%)		
		Increase	Decrease	About the same
Aluminum	− 8.9	33.2	19.9	46.9
Beryllium copper	−19.0	20.6	16.2	63.2
Brass	−11.6	31.9	18.1	50.0
Bronze	+12.0	23.5	15.7	60.8
Copper	−19.7	28.6	21.4	50.0
Nickel	−46.9	28.2	7.7	64.1
Alloy steel	+ 4.9	37.5	16.3	46.2
Carbon steel	+13.1	38.6	14.7	46.7
Galvanized steel	− 4.8	33.6	17.8	48.6
Polished steel	−29.0	17.1	25.7	57.2
Pre-finished steel	− 0.5	27.3	13.6	59.1
Stainless steel	−31.4	35.4	15.9	48.7
Terne plate	−25.0	13.5	13.5	73.0
Tin plate	− 2.6	23.3	23.3	53.4
Other	− 5.9	—	—	—

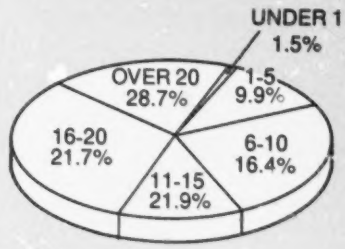
WHERE METALS ARE PURCHASED:

	No. of plants	Percentage of reported poundage
Steel service center	153	40.2
Pre-slit coils from mill	107	46.1
Wide coils to be slit in-plant	16	13.6

STAMPING PRESS BUYING PLANS

Size (tons)	Mechanical		Hydraulic		Total
	No. of plants	No. of presses	No. of plants	No. of presses	No. of presses
1-10	4	13	4	8	21
11-50	32	106	1	1	107
51-100	33	58	2	2	60
101-500	40	54	8	9	63
over 500	7	27	2	2	29
Total	**84**	**258**	**17**	**22**	**280**

STAMPING PRESS BREAKDOWN BY AGE



Age figures are in years
Based on 446 responding plants

STAMPING PRESSES INSTALLED

Size (tons)	Mechanical		Hydraulic		Total	
	Respondents have	Projected ind. total	Respondents have	Projected ind. total	Respondents have	Projected ind. total
1-10	972	22,000	339	7,600	1311	29,000
11-50	3034	68,000	146	3,000	3180	71,000
51-100	1594	36,000	133	3,000	1727	39,000
101-500	993	22,000	90	2,000	1083	24,000
over 500	201	4,500	45	1,000	246	5,500
Total	**6794**	**152,000**	**753**	**17,000**	**7547**	**169,000**

Based on 446 responding plants

AUXILIARY EQUIPMENT

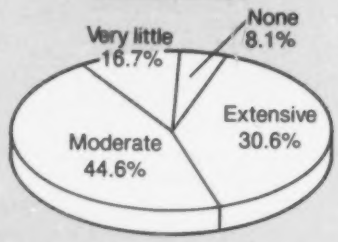
Type	Now installed				Plan to buy by end 1983	
	No. of plants	No. of machines	Average/ plant	Projected ind. total	No. of plants	No. of machines
Acoustic enclosures	76	337	0.8	7,600	19	89
Bending rolls	114	273	0.6	6,100	7	12
Coil cards	42	182	0.4	4,100	8	9
Coil coaters	14	61	0.1	1,400	2	3
Coil cradles	208	1346	3.0	30,000	29	48
Coil end joiners	30	216	0.5	4,800	2	2
Coil reels	261	2000	4.5	45,000	30	57
Coil slitters	50	115	0.3	2,600	3	4
Coil tippers	20	85	0.2	1,900	5	7
Conveyors, pre-cut stock	60	279	0.6	6,300	12	31
Cut-off equipment	167	536	1.2	12,000	13	21
Die cushions	166	1399	3.1	31,000	10	37
Die cylinders (hydraulic)	67	524	1.2	12,000	7	31
Die cylinders (nitrogen)	51	365	0.8	8,200	7	42
Lubricators	220	3007	6.7	67,000	27	226
Nibblers	146	329	0.7	7,400	7	11
Notchers	98	186	0.4	4,200	4	6
Press brakes	246	1212	2.7	27,000	15	26
Press controls	158	2358	5.3	53,000	27	61
Press feeds	283	3196	7.2	72,000	44	108
Scrap choppers	154	1021	2.3	23,000	11	29
Scrap conveyors	104	578	1.3	13,000	12	30
Spinning machinery	25	139	0.3	3,100	2	4
Stackers, pre-cut stock	36	99	0.2	2,200	4	5
Stock straighteners	216	1260	2.8	28,000	26	85
Trimming machines	60	421	0.9	9,400	4	24

Based on 426 responding plants

NEW DIES IN 1981

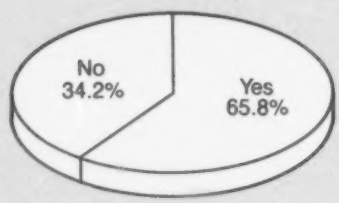
379 responding plants used 16,186 new dies in 1981
Average/plant: 42.7
Projected industry total: 427,000 die sets

REPAIR/REWORK CAPABILITIES



These are rework/repair capabilities of plants that do not make their own dies.

DO PLANTS MAKE OWN STAMPING DIES?



Based on 148 responding plants

EXPENDABLE SUPPLIES

Die lubricants: 255 respondents used 153,907 used 153,907 gallons in 1981
Average plant: 604 gal.
Projected industry total: 2,900,000 gal.
Hydraulic fluid: 87 respondents used 92,394 gallons in 1981
Average/plant: 1062 gal.
Projected industry total: 1,800,000 gal.

END-USE INDUSTRIES

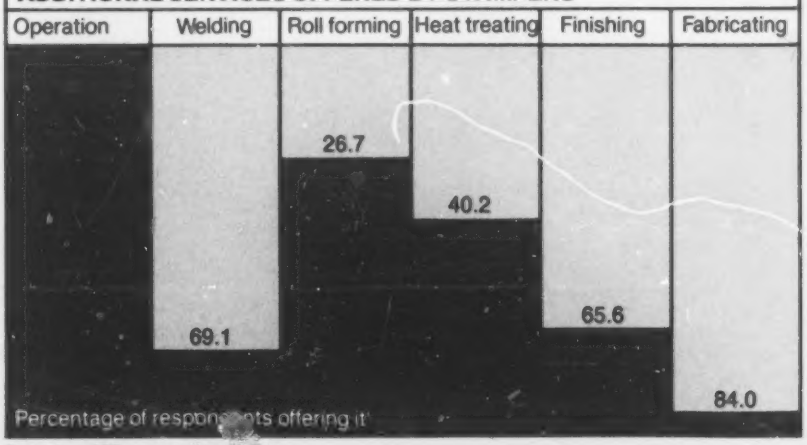
	No. of respondents	Percentage of shipments
Automotive	138	11.3
Other transportation	111	7.8
Construction	146	16.8
Furniture	95	8.7
Appliances	116	9.2
Aerospace	80	5.6
Electrical equipment	63	11.4
Farm machinery	29	4.6
Medical equipment	11	1.8
Other	174	22.8

respondents plan to buy by the end of 1983. Nearly half of the presses installed in the industry are over 15 years old.

The majority of our respondents make their own stamping dies. Most of the plants which don't have some sort of rework facilities. Secondary operations are performed by most of our respondents, with fabricating, welding and finishing done most often.

Stampings are used in almost every industry. The end-use industries most commonly reported by our respondents are the construction, automotive and electrical equipment industries.

ADDITIONAL SERVICES OFFERED BY STAMPERS



Based on 430 responding plants